Federal Democratic
Republic of Ethiopia

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ET 985 (2004) (English): White Sugar - Specification

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ETHIOPIAN
STANDARD

ES 985:2004

(Reaffirmed: 2012)

First edition

White sugar - Specification

ICS: 67.180.10

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Foreword

This Ethiopian Standard has been prepared under the direction of the Technical Committee for Sugar and Sugar Products (TC 22) and published by the Ethiopian Standards Agency (ESA).

The standard is a reaffirmation for reprint of the Ethiopian Standard ES 985:2004, White sugar - Specification with some editorial changes without altering the technical contents in the former text.

White sugar — Specification

1 Scope

This Ethiopian Standard specifies requirements, sampling, and method of test for white sugar

2 Normative reference

The following Ethiopian Standard contains, which, through reference to this text, constitute provisions of this Ethiopian Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on these Ethiopian Standard are encouraged to investigate the possibility of applying the most recent editions of the Ethiopian Standard indicated below. Registers of currently valid standards are maintained in the Ethiopian Standards Agency.

ES 261 Drinking water– specification

ES 359 General Standard for the labeling of prepackaged foods:

ES 988 Determination of arsenic silver diethyl ditches

ES 989 Determination of lead in food

3 Definitions

For the purpose of this Ethiopian Standard the following definitions shall apply:

3.1

refined white sugar

Shall mean white sugar, which has been further purified to obtain white, odorless, crystalline sugar free from an extraneous matter.

3.2

Plantation white or mill sugar

shall mean crystalline sugar off white in color, manufactured by the vacuum pan process.

4 Requirements

4.1 General

4.1.1 White sugar shall be, white, odorless and free from any taste except the characteristic taste of sucrose and shall comply with the requirements given in the following tables.

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Table I: Chemical requirements for white sugar

Ser. No	Characteristics	Requirements		Methods of test
		Refined white sugar	Plantation white sugar	
1	Polarization value, ^{0}Z min.	99.70	99.5	Annex A
2	Moisture, % by mass max.	0.010	0.10	Annex B
3	Reducing sugars, % by mass max.	0.04	0.10	Annex C
4	Color in ICUMSA units, max.	60	150	Annex D
5	Conductivity ash, % by mass max.	0.04	0.10	Annex E
6	Sulphur dioxide mg/kg max	20.0	70.0	Annex F
7	Insoluble matter, % by mass max.	-	0.01	ES 987 Annex D

4.1.2 White sugar shall comply with the requirements of heavy metals limits given below

Table II Heavy Metals Requirements.

Ser No.	Heavy metals	Limits	Test method
1	Arsenic (As) mg/kg	1.0	ES 988
2	Copper (Cu) mg/kg	2.0	Annex G
3	Lead (Pb) mg/kg	0.50	ES 989

4.1.3 White sugar shall also comply with the microbiological requirements give in the following table

Table III: Microbiological Requirements

Ser No	Characteristics	Requirements	Test method
1	Total plate count per gram, max.	500	ES ISO 4833
2	Coli forms per gram	Less than 3	ES ISO 4831
3	Yeasts and moulds per gram ,max	50	ES ISO 7954

4.2 Hygiene

4.2.1 Unsuitable growing or harvesting areas

Sugar cane shall not be grown or harvested where the presence of potentially harmful substance would lead to an un acceptable level of such substances in the sugar.

4.2.2 Protection from contamination by wastes

Sugar cane shall be protected from industrial and agricultural wastes which may be present at levels likely to be hazard to health. Adequate precautions shall be taken to ensure that wastes are not used and are not disposed off in a manner, which may constitute a hazard to health through sugar.

4.2.3 Irrigation

Sugar cane should not be grown in areas where the water used for irrigation might constitute a hazard to health to the consumer through the sugar.

4.2.4 Pest and disease control

Control measures involving treatment with chemical, physical or biological agents should only be undertaken under direct supervision of personnel who have a though understanding of the potential hazard to health.

4.2.5 Harvesting and production

Methods and procedures associated with harvesting and production should be hygienic and such as not to constitute a potential hazard to health or result in contamination of the sugar.

4.2.6 Construction and condition of the factory

4.2.6.1 The roof shall be weather proof and the ceiling, if present shall be, dust proof.

4.2.6.2 The floors and inside surfaces of walls shall be constructed of material impervious to water and shall be kept clean.

4.2.6.3 General illumination shall be such as to permit effective processing and cleaning.

4.2.6.4 The ventilation shall be such as to effect the removal of excess team and prevent the formation of condensate that may fall in to raw materials, or the product, or on to equipment coming in to contact with them. Natural ventilation shall be augmented, if necessary, by mechanical means.

4.2.6.5 Effective measures shall be taken to keep the factory free from flies and other injects

4.2.6.6All premises, on which the product is prepared, packed, or stored shall be rodent proof and shall be kept free from rodents

4.2.6.7 Insecticides, rodenticides, and cleaning materials shall not be used while processing is in progress and every precaution shall be taken to ensure that equipment and working surfaces are free from insecticide and rodenticidal residues.

4.2.6.8 Drains shall be kept clean

4.2.6.9 No, factory chimney or motor exhaust shall emit smoke or fumes in a quantity or in a manner that is offensive, injurious, or dangerous to health or that causes contamination of the product.

4.2.6.10 Wash basins with germicidal soap an adequate supply of clean hot and cold running water, and paper towels or hot air hand dryers shall be provided at least at one convenient point in the processing area of the factory.

4.2.7 Plant and equipment

All plant and equipment used to prepare, handle, transfer, or store the product shall be made of suitable corrosion. Resistant material and shall be kept clean and in good condition.

4.2.8 Non-edible stores and spare parts for machinery shall be housed in a part of the factory a way from the processing area.

4.2.9 Water for processing, washing, and plant cleaning purposes shall comply requirements for drinking water ES.261: 2001

4.2.10 Requirements for Employees

4.2.10.1 No person suffering from or who is a carrier of any communicable disease or is suffering from infected wounds, sores, shall be permitted to engage in the processing of the product.

4.2.10.2 No person suffering from any cut or injury shall be engaged in the processing of the product unless the cut or injury has been treated

4.2.10.3 neither personal effects of workers nor their food shall be present, consumed or prepared in the processing and packing areas of the factory.

4.2.10.4 Spitting and the use of tobacco in any form shall be prohibited in the processing and packing areas of the factory.

4.2.10.5 Every person engaged in processing and handling area shall maintain a high degree of personal cleanliness while on duty and shall at all times wear suitable protective clothing including head covering and foot wear.

4.2.10.6 Persons who come in contact with the product in the course of their work shall have a medical examination prior to their employment.

4.2.10.7 Adequate, suitable and conveniently located dressing room facilities, toilets, shower-baths, wash basins with hot and cold water shall be provided. Where possible hygienic means of drying hands towels sufficient number dispensers and receptacles shall be available adjacent to each washing facilities. The facilities shall be furnished with properly trapped waste pipes leading to drains.

5.Packing and labeling

5.1 Packing

5.1.1 White sugar shall be packed in clean and sound materials that will afford it adequate protection during storage transportation distribution and use.

5.1.2 each bag shall have a net mass of 5,10,25,50 and 100 kg.

5.2 Labeling

5.2.1 Labeling of white sugar shall be done in accordance with ES 359 General Standard for the labeling of pre packed foods and shall include the following information.

I. Type of the product
II. Name and address of the manufacturer
III. Net mass of the product in kg
IV. Batch or code number
V. Date of production

6 Storage and stacking

6.1 Storage

6.1.1 White sugar shall be stored under conditions, which provide protection against contamination and minimize damage and deterioration.

6.1.2 Sugar shall be stored in clean, sound and dry bags to protect sugar from rodents and quality deterioration.

6.1.3 All bags prior to storage shall be examined for damage due to moisture, dampness, fungus or deleterious contaminants; those unduly damage or torn bags shall be discarded or replaced.

6.1.4 During storage periodic inspection of the sugar bags shall take place to ensure that no quality deterioration has occurred due to moisture or other contaminants.

6.1.5 If it is observed that damage of bags caused by dampness, see page of water from the floor, or from the walls or due to leakage of rainwater, the source of dampness or rain shall be removed by adopting the necessary measures for protection against ingress of dampness or rain. The stack shall be broken and the damaged bags shall be segregated.

6.1.6 The storage area of sugar shall be located on a raised, well-drained site not liable to flooding and if possible it shall be away from a placelikely to be affected by seepage water.

6.1.7 The store shall have smooth, crack free internal surfaces and shall have no unnecessary cavities and projections in order to prevent the lodgment of insects and vermin.

6.1.8 The storage area of sugar shall be located for away from spray ponds and in such a way that the prevailing wind direction does not carry the spray of moisture laden to the warehouse. Other sources of moisture, such as exhaust blow off, boiler blow downs condenser water channels and storm water drains shall be led in the direction away from the go downs.

6.1.9 As far as possible the warehouse shall not be near the place where molasses are stored or where the presumed is discharged or where the effluents of the factory are let out. These are the places of intense activity of microorganisms and serve as sources of contamination and spoilage of sugar.

6.1.10 The warehouse shall as far as possible, be adjacent to the bagging machine in a sugar factory. To facilitate the transportation of bags to the store.

6.1.11 The store shall be well ventilated to maintain a working environment that avoids excess humidity and condensation.

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6.2 Stacking

6.2.1 According to the capacity of the store, the floor area shall be marked in to rectangular or square stock spaces care shall be taken that all alleyways of at least one-meter width are left between the stack and walls and about 1.5 meters in between the stacks. For the purpose of obtaining maximum capacity of the store it is recommended that there should be one stack spreading lengthwise having one-meter alleyway on all sides. For the sake of convenience each stack shall contain sugar of the same quality or grade.

6.2.2 The stack shall be so built that when completed it is stable and perfectly cuboids in shape and also that all peripheral bags on faces of the stack are in one plane or without any face of the stack bulging outward or in ward at any point.

6.2.3 Sugar bags shall be stacked in a way so as to give the maximum strength to the stack. The stacking shall be done with one layer lengthwise and another breadth wise.

6.2.4 While estimating the height of stacks care shall be taken to ensure that minimum space of about two meters is left between the top surface of the stack and the top of walls or the bottom of trusses employed for support of the roof. The height of the stack. However, depends upon the strength or load bearing capacity of the bags used for storing sugar.

6.2.5 Suitable provisions of first aid supplies and fire extinguishers shall be made available to safeguard against any accidental explosion or fire.

7.1 Transportation and Conditions of maritime transit

7.1.1 Transportation

7.1.1.1 The loads of sugar, either at the loading or un loading point, shall not be kept at a dirty or damp place or a place considered. Otherwise deleterious for keeping sugar. During their transport, they shall be held secure so that they do not drop or otherwise get damaged, and shall always be well protected from rain.

7.1.1.2 The mouth of each bag meant for transport shall be stitched with machine or manually in which case the mouth shall be rolled over and given 14 stitches in each row. In case of machine stitching 3-ply thread stitching with 18 twist giving about 5 stitches in 2.5 cm shall be used.

7.1.1.3 Bags shall not be loaded or unloaded otherwise handled in the open if it is raining

7.1.1.4 During transport of a consignment of bags either in a vehicle or train or in any other conveyance; no tolerance for loss in weight of total bags shall be allowed. 100 percent bags of a consignment meant for transport shall be weighted prior to loading in either a vehicle, or train or in any other conveyance at the loading point, and then again re-weighed at the unloading point.

7.1.1.5 A vehicle, which is either damp dirty or containing deleterious contamination, shall not be used for the transport of bags.

7.1.1.6 The vehicle shall have a sound floor so that even if the bags burst or other wise get damaged during transport, the sugar does not spill out of the vehicle. The floor of the vehicle shall be scrubbed clean and dry.

7.1.1.7 A vehicle shall not be loaded to more than its certified capacity.

7.1.1.8 The bags shall be stacked in the vehicle according to a stack plan avoiding bags and lop-sided heaping and also ensuring compact and balanced stacking so as to make the bags least susceptible to movements and jerks due to the movement of the vehicle.

7.1.1.9 The stack in the vehicle shall be tied securely so that when the vehicle is in motion, the bags do not get dislodged or drop out.

7.1.1.10 During rainy weather, the stack in the vehicle shall be covered with sound, clean and dry waterproof canvas or any other material in such a manner that when it rains, the water does not reach the bags. The loose edges of the covering material, covering the sides of the stack shall be well spread over so as to hang free over the sides of the vehicle and not tucked under the stack.

7.2 Conditions of maritime transit

7.2.1 Port of embarkation and disembarkation

7.2.1.1 The floor, on which stacks are built, shall be dry and clean. As far as possible, care shall be taken to provide a place having a leak proof roof and sound solidly built floor for the storage of bags. If the floor is not solidly built, or otherwise unsuitable for the storage of sugar, dunnage of timber pallets shall laid on the floor before the bags are stacked at the port of embarkation.

7.2.1.2 The time during which bagged sugar loaded on to vehicles or in to freight containers are awaiting transfer to a ship shall be keptto a minimum days.

7.2.1.3 Sugar shall not be loaded in to leaky, odorous or unsanitary ships or containers, nor in to containers whose ceilings walls or floor are wet or show sign of dampness.

7.2.1.4 During loading and discharging of sugar bags it shallbe protected from potentially contaminating cargo

7.2.1.5 Sugar in bags shall not be placed on an unclean or contaminated wharf surface.

7.3 Maritime transport

7.3.1 Ships holds shall be clean and dry prior to loading

7.3.2 Sugar cargo shall be protected from salt-water damage and ship sweat storage of sugar next to or in the area of potentially contaminating cargo (for example, chemicals, pesticides odorous or dusty materials) or other commodities that might possibly affect the quality of sugar shall be avoided.

8 Sampling of white sugar

8.1 General requirements.

8.1.1 Samples shall be taken in a protected place no exposed to damp, air, dust or soot.

8.1.2 The sampling instruments shall be clean and dry when used.

8.1.3 A sampling tube or an appropriate instrument shall be used.

8.1.4 Precautions shall be taken to protect the samples, the material being sampled, the sampling instruments and containers for samples from adventitious contamination.

8.1.5 The samples shall be placed in clean dry, and moisture-proof containers.

8.1.6 The sample containers shall be sealed airtight, after filling, and marked with full details of sampling, the date of sampling, grade of sugar, name of the manufacture Name of sampler and other important particulars of the consignment.

8.2 Scale of sampling

8.2.1 Lot - All the bags in a single consignment declared to contain sugar of one grade should constitute a lot. If a consignment is declared to consist of different grades, the bags belonging to the same grade shall be grouped together and each such group shall constitute separate lots.

8.2.2 Samples shall be tested separately for each lot for ascertaining the conformity of the graded sugar.

8.2.3 The number of sugar bags to be selected from the lot shall depend on the size (N) of the lot and shall be in accordance with column 1 and 2 of the following table.

8.2.4 Sugar bags shall be selected at random. In case of sugar bags stacked in a paramedical snap approximately equal number of bags shall be selected from all exposed sides of the lot , so as to give the required number of sample bags.

Table 3: Number of sugar bags to be selected from the lot for sampling

Lot size	Number of bags to be selected
2 to 7	2
8 to 25	8
26 to 100	13
101 to 500	32
501 to 1000	50
1001 and above	80

8.3 Preparation of samples

8.3.1 From top middle and bottom portions of each of the selected bags approximately equal quantity of sugar shall be taken with the help of a suitable sampling instrument. The sample collected from each of the bags shall be thoroughly mixed so as to give composite sample of 600 grams. The composite sample thus prepared shall be divided approximately in to three equal parts, one for the customer one for laboratory test and the third for the reference, sealed airtight and stored for usein case of dispute.

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Annex A

(normative)

Determination of Polarization of Sugar by Polarimetry

A1. Scope

This method is applicable to all raw sugars, white sugars and specially sugars requiring clarification

A2 Principle

A2.1 There are three basic steps

A2.1.1 Preparation of a normal solution of sugar in distilled water

A2.1.2 Defecation by addition of basic lead acetate solution and clarification by filtration.

A2.1.3 Determination of the polarization by measurement of the optical rotation of the clarified solution.

A3 Definitions

A3.1
Normal sugar solution
shall mean 26.0160g of pure sucrose weighed in vacuum and dissolved in pure water at 20^0c to a final volume of 100ml

A3.2
International sugar scale
shall mean the optical rotation of the norma l sugar solution at the wavelength of the green line of mercury iso tope 198 Hg.

A4.Apparatus

A4.1 Analytical balance – readable to 1mg

A4.2 Volumetric flask 100ml

A4.3 Automatic dispenser for lead acetate. To avoid contact with carbon dioxide in the air , fit a cartridge containing a mixture of calcium and sodium hydroxides or equivalent, to the air inlet of the dispenser

A4.4 Polarimeter calibrated in sugar degrees (^{0}Z) at. 20^0c

A4.5 Quartz plates certified by a recognized authority

A4.6 Stem less funnel

A4.7 Filter paper, whatman No. 91 or equivalent

A4.8 Polarimeter tubes

A4.9 Water bath maintained at20± 0.5^0c

A4.10 Thermometer readable to 0.1^0c over the range 0-50^0c;

A5 Reagents

A5.1 Basic lead acetate solution. Dissolve 560g of basic lead acetate in about 1 liter of distilled water. Boil for about 30 minutes and allow to settle. Decant the supernatant liquid and dilute to a density of 1.24 or 24.4g Pbo/100ml total lead content with recently boiled distilled water. Check the total lead content by measuring the density accurately. This solution should be protected from contact with carbon dioxide.

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A6 Procedure

A6.1 Weight out accurately 26.000± 0.002g of the sugar as rapidly as possible

A6.2 Transfer the sugar to 100ml volumetric flask by washing with distilled water to a volume not exceeding 70ml.

A6.3 Dissolve the sugar by hand swirling or using mechanical shaker

A6.4 Add basic lead acetate solution according to the expected polarization ofthe sugar

Below 99.3 ^{0}z use 1.0 ± 0.05ml

Above 00.3 ^{0}z use 0.5 ± 0.05ml

A6.5 Mix the solution by gentle swirling and suing the same motion,add distilled water until the bulb of the flask is full.

A6.6 Allow to stand for at least 30 minutes in water bath maintained at 20± ^{0}c. If water bath is not available measure the temperature of the solution in the polarimeter tube after reading

A6.7 Fill the flask to the calibration mark with distilled water and If there is a foam break it with one drop of ether or alcohol

A6.8 Dry the inside of the neck of the flask above the liquid with a rolled filter paper.

A6.9 Shake thoroughly again and allow to stand for 5 minutes to permit settling of the precipitate.

A6.10 Filter through a fluted filter paper whatman No. 91 or equivalent using a stem less funnel, covering the funnel with a watch glass to minimize evaporation. Discard the first 10ml of filtrate and collect 50 to 60 ml.

A6.11 Rinse the polarization tube thoroughly at least twice with the solution to be used and fill in such a way that no air bubbles are entrapped.

A6.12 Screw on the caps of end filling tubes only as tightly as is necessaryto prevent leakage.

A6.13 Place the tube in the polarimeter and read the polarization at 20^{0}c.

A6.14 Calibrate the polarimeter by reading certified quartz plates for every series of samples and correct the reading obtained to the normal values of the plate .

If the reading made other than 20^{0}C, the temperature effect correction for polarimetre:

$$P_{20} = P_t + 0.019\ (tr - 20)$$

Where,

P_{2O} = Polarization at 20^{0}c

P_t = Polarization as measured at t^{0}c

t_r = temperature of the solution in ^{0}c as read in the polarimeter..

Annex B
(normative)

Determination of Sugar Moisture by Loss on Drying

B1. Scope

This method is applicable to all white sugars and raw sugar containing less than 0.5% moisture.

B2 Principle

The principle of the method is oven drying using the atmospheric pressure oven technique at 105 ^{0}c followed by cooling after oven drying. It is mainly free moisture, which is estimated by this method.

B3 Definitions

For the purpose of this Ethiopian Standard following definitions shall apply

B3.1

Los on drying

shall mean the mass lost on drying due to specific heat and pressure

B3.2

Free moisture

shall mean the moisture contained on the surface of the crystal, which is easily and quickly removed on drying.

B3.3

Bound moisture

shall mean the moisture contained in the glassy layer on the surface and in the re-entrant angles which is only released slowly as the glass crystallizes

B3.4

Inherent moisture

shall mean the moisture included within the crystal structure and only released in general by grinding.

B4 Apparatus

B4.1 Forced-draught atmospheric pressure oven maintained at 105± 1^{o}c

B4.2 Desicator containing self-indicating silica gel.

B4.3 Dishes with tight fitting lids made of platinum, aluminum, nickel, stainless steel

B4.4 Analytical balance readable to 0.1mg

B5 Procedure

B5.1 Place the empty dish, with the lid off, in the oven at 105± 1^{o}c at least 30 minutes

B5.2 Remove the dish from the oven and put on the lid cool in the desiccator to room temperature for one hour. Weigh to the nearest ± 0.1mg

B5.3 Place, as quickly as possible, 20 to 30g of sample into the dish put on the lid; and weigh to ± 0.1mg. the depth of the sugar in the dish must not exceed 1cm.

B5.4 Return the dish to the oven at 105 ^{o}c ± 1^{o}c, remove the lid and dry for exactly 3 hours. Ensure that there are no other materials in the oven during the drying period. No attempt should be made to dry to constant mass and care should be taken to ensure that there is no physical loss of sugar at any stage

B5.5 At the end of the drying period, remove the dish from the oven, and replace the lid. Coo in the desiccator to room temperature for one hour. Weigh the dish and it's contents to an accuracy of ± 0.1mg.

B5.6 Calculation

Loss on drying (taken as % moisture) = $100\,\frac{(W_2 - W_1}{M}$

W_1 = Weight of the empty dish plus lid
W_2 = Weight of dish plus lid after drying
M = Mass of the sample taken for test.

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Annex C

(normative)

Determination of Reducing Sugar by the Lane and Eynon Constant Volume Method

C1 Scope

This method is used for the determination of reducing sugars in sugars in the presence of sucrose. It is applicable to raw, refined white, plantation white, icing and cube sugars.

C2 Principle

C2.1 The main part of the test solution is added to a definite volume of a strongly alkaline cupric -complex salt solution, (Fehling's solution) which is then boiled. In constant volume, at the end point the final volume, and concentration of the Fehling's solution in the reaction flask has been kept constant by the prior addition of a predetermined amount of water.

The experimental conditions including volume and concentration of Fehling's solution, time of boiling and final volume of reaction mixture, are strictly defined.

C3 Definitions

For the purpose of this Ethiopian Standard the following definitions shall apply.

C3.1

Reducing sugar .

Shall mean primarily glucose and fructose present in sugar.

C3.2

Invert sugar

shall mean an equimolar mixture of glucose and fructose.

C4. Apparatus

C4.1 Volumetric flask

C4.2 Thermometers

C4.3 Hot plate

C4.4 Analytical balance

C4.5 Timer indicating minutes and seconds

C4.6 Flasks, Pyrex-flat-bottomed, 300ml

C4.7 Burettes 50 ml

C4.8 Water bath maintained at 20 ± 1 ^{0}C

C4.9 Filter funnel

C5 Reagents

C5.1 Hydrochloric acid concentrated Sp.gr. 1.19

C5.2 Benzoic acid

C5.3. Methylene blue solution, 19/100ml. Dissolve 1g of methylene blue in water and make up to a volume of 10ml

C5.4 Sodium hydroxide solution approximately 1N. Dissolve 40g of sodium hydroxide in 500 ml of water. Cool the solution, transfer to a 1 liter volumetric flask and make up to the volume with water.

C5.5 Hydrochloric acid 0.5N dilute 44.5ml of concentrated Hydrochloric acid to 1 Liter.

C5.6 EDTA Sodium salt solution 40g/l. Dissolve 20g of the salt in water and makethe volume up to 500 ml

C5.7 Anti foam liquid paraffin or any other antifoam, which does not reduce Fehlig's solution.

C5.8 Phenolphthalein solution, 1g/100ml. Dissolve 1g of phenolphthalein in 60ml denatured alcohol and make up to a volume of100ml withwater

C5.9 Standard invert solution, 2.5g/l Weigh 9.50g of sucrose and transfer with out loss to a 1 liter volumetric flask with the aid of 100 ± 5 ml of water.

C5.9.1 Add 5ml of concentrated hydrochloric acid to the sucrose solution mix gently during the addition. Stopped the flask and allow to stand for complete inversion. Inversion is complete on standing for 3 days at 20 -25^{0}C or 8 days at 12-15^{0}C.

C5.9.2 Dilute the invert solution with water to approximately 800ml.

C5.9.3 Dissolve l2g of benzoic acid in 75ml of hot water and add the benzoic acid solution to the invert solution. Finally make the solution volume up to 1L at 20^{0}c and mix thus producing 10g/l invert sugar solution.

C5.9.4 Prepare a neutral 2.5g/L standard invert solution by pipetting 5 0ml of the 10g/L invert solution into 200ml volumetric flasks and add two drops of phenolphthalein solution. Add sodium hydroxide solution 1N, with gentle agitation until pink color develops. Discharge the pink color of the invert solution by addition of one or two drops of 0.5N hydrochloric acid. Finally make the solution up to the volume with water and mix. Prepare this solution, immediately before use.

C5.10 Fehling 's solution (soxhlet's modification) prepare by mixing immediately before use, equal volume of solution A and solution B.

C5.10.1 Solution A. Dissolve 34.64g of cupric sulphate pentahydrate in 500ml volumetric flask with distilled water and dilute to volume

C5.10.2 Solution B. Dissolve 173g of potassium sodium tartaret and 50g of sodium hydroxide in 500 ml volumetric flask with distilled water and dilute to volume.

C5.10.3 Mixed Fehlings solution. Mix together equal volumes solution A and solution B by poring solution A into solution B whilst stirring with a glass rod filter if necessaryand store in suitable stoppered container.

C5.11 Boiling chips or glass beads.

C6 Procedure

C6.1 Standardization of the Fehling's solution.

C6.1.1 Adjust the heating appliance/hot plate/ so that 75 ml of water contained in the boiling flask begins boiling from room temperature in a period of 2.5 minutes ± 5 seconds. Small quantity of boiling chips or glass bead should be added to the flask to ensure even boiling.

C6.1.2 Rinse and fill 50ml burette with the 2.5g/L standard invert solution and fill another 50ml burette with distilled water

C6.1.3 Pipette 20ml of the mixed Fehling's solution in to the boiling flask and add from the burette 15ml of water.

C6.1.4 Add 39ml of the standard invert solution from the burette giving a total volume of 74ml. Add small quantity of boiling chips or glass beads, few drops of antifoam. Mix the solution by gentle swirling

C6.1.5 Place the flask on hot plate and allow the solution to reach the boiling point. Start the timer and allow the solution to boil for exactly 2min.

C6.1.6 Add 4 drops of methylene blue indicator solution. Complete the titration by slow addition of the invert solution from the burette.

C6.1.7 Add the invert solution in small increments, which are progressively reduced, starting with additions of 0.2ml then 0.1ml and finally drop wise.

copper sulphate or dilution with water for any adjustment carryout standardization procedure again. When the Fehling's solution is of the correct strength then 20ml is equivalent to 100mg of invert sugar.

C6.2 Sample solution

C6.2.1 Transfer accurately weighed amount of the sugar normally 10 to 40g in to a 100ml volumetric flask, dissolve in 50 to 60ml of distilled water and mix thoroughly. Make up to the mark with distilled water and shake well.

C6.2.2 Adjust the weight of the sugar sample so as to give a concentration of 250 to 400mg/100ml of reducing sugars in the solution referring to the respective specification.

C6.2.3 Add 3ml EDTA solution per gram of sample for pan product once the sample has dissolved but prior to making to the mark with distilled water.

C6.2.4 Where the invert sugar concentration of the test solution falls bellow 250mg/100ml, add known amount of standard invert solution to bring the resultant dilute sample up to a final invert concentration within the desired range.

C6.2.5 Sample titration

C6.2.5.1 Ensure that the heating appliance is operating under the prescribed conditions and then rinse and fill the burette with the test solution. Take another burette, fill with distilled water and carry out the preliminary test.

C6.2.5.2 Pipette 20ml of Fehling's solution in to the boiling flask, run in 20ml of the sample solution, add small quantity of boiling chips or glass beads and few drops of antifoam.

C6.2.5.3 Place the flask on the heating appliance, allow the solution to reach the boiling point and add 4 drops of methylene blue indicator. If the blue color of the solution is discharged the test solution is too concentrated and less concentrated solution must be prepared.

C6.2.5.4 Titrate by initially adding increments of 2ml of the test solution and progressively reducing the addition down to 0.2ml and attempting to obtain the end point in about 1 minute from the time the solution commences boiling. The end point is denoted by the absence of the blue color of the indicator. Record the titre.

C6.2.5.5 Carry out a further test adding to the boiling flask, 20ml of Fehling's solution, the volume of test solution obtained from the first titration less 0.5ml and sufficient water from the burette to give a volume of 75ml. After 2 minutes boiling add 4 drops of methylene blue and complete the titration initially with 0.1ml increments and finally drop wise. The titration should be completed at the end of a further 1 minute ± 5 seconds giving a total boiling time of 3 minutes ± 5 seconds. Record the tire and use it to calculate the reducing sugars .Repeat this precise titration.

C6.3 Calculation

Reducing sugars, % by mass = $$\frac{1000f}{V1C1} - \frac{CsVs}{C1}$$

Where

C_1 = is concentration (g/100ml) of sample in the test solution

V_1= is the volume (ml) of the test solution used in the titration

C_s = is the concentration (g/100ml) of the standard invert added, If necessary

V_s= is the volume (ml) of any invert added in the test solution

f = is the correction factor based on the amount of sucrose present shown in the table below. If necessary calculate the amount of sucrose per 100ml o f titratng solution from the weight of sample and its approximate percentage sucrose.

Table1: Sucrose correction to be applied in Lane and Eynon constant volume method.

g sucrose present in test volume of solution	Correction factor
0.0	1.00
0.5	0.988
1.0	0.975
2.0	0.950
3.0	0.934
4.0	0.917
5.0	0.906
6.0	0.894
7.0	0.884
8.0	0.874
9.0	0.865
10.0	0.856
12.0	0.844
14.0	0.829
16.0	0.816
18.0	0.805
20.0	0.794

The amount of sucrose present in the mixture, g, is equal to sucrose (g/100ml) in the titrating mixture X 0.01V1

When no invert is added the second term is zero and

$$\text{Reducing sugars, \%} = \frac{10000\,f}{V1C1}$$

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Annex D
(normative)

Determination of White Sugar Solution Colour

D1 Scope
This method is used for the determination of white sugar solution color. The method can be applied to all crystalline or powdered white sugars provided that a filtered test solution can be prepared by the procedure specified in the method. This method is not suitable for those sugars which contain coloring matter, turbidity or additives to an extent that filtration is not practical.

D2 Principles
White sugar is dissolved in a buffer solution to give a sugar solution with a $_{P}$H of 7.0. The solution is filtered through a membrane filter to remove turbidity. The absorbance of the filtered solution is measured at a wavelength of 429nm and the solution color is calculated.

D3 Definitions
For the purpose of this test method the following definitions shall apply.

D3.1
ICUMSA color
shall mean the value of the absorbance index multiplied by 1000. The resulting values are designated as ICUMSA units.

D4 Reagents

D4.1 Triethalonamine solution, 0.1mol/L. Dissolve 7.460g of triethalonamine liquid in water, transfer to a 500ml of volumetric flask

D4.3 Triethanolamine/Hydrochloric acid buffer solution. Transfer 500ml of the triethanolamine solution of 0.1 mol/L to a

D4.4 One liter beaker and whilst stirring, with a P^{H} electrode immersed, adjust the solution to P^{H} 7.0 with the 0.1 mol/L Hydrochloric acid. This should require about 420ml of the hydrochloric acid solution to give a final volume of 920ml of TEA/HCl buffer solution. This buffer should be prepared a day before use and stored at 4 ^{0}C.If necessary adjust the pH to 7 before use.

D5 Apparatus

D5.1 Spectrophotometer, capable of light transmission measurements at a wavelength 420nm.

D5.2 Cells, 4cm, 10cm,.

A cell length of 10cm or more is to be preferred for low color white sugars reference cell may be used, provided that a test with distilled water has shown that the two cells are with in the range of 0.2% or being identical.

D5.3 Membrane filter pore size 0.45μm and diameter 50mm.

D5.4 Membrane filter holder

D5.5 Vacuum oven, vacuum desiccator or ultrasonic bath for deaeration of the filtered sugar solution.

D5.6 Refractometer

D5 7 Analytical balance readable to 0.1g

D6 Procedure

D6.1 Weigh 50 ± 0.1g of sugar sample in to a 250ml conical flask, add 50.0 ± 0.1g of TEA/HCl buffer solution and dissolve the sugar by swirling at room temperature.

D6.2 Filter the sample solution through a membrane filter into clean and dry conical flask

D6.3 De-aerate the solution by means of vacuum oven, vacuum desiccator for one hour or inanultrasonicbathfor3minutes.

D6.4 Measure the refractometeric dry substance (RDS) of the solution to an accuracy of± 0.1g/100g. (Brix)from Annex H

D6.5 Colour measurement

D6.5.1 Set up the instrument according to the manufacturer's instruction and adjust the wavelength to 420nm.

D6.5.2 Rinse the measuring cell with sugar solution and then fill. Determine the absorbance of 420nm using filtered de-aerated TEA/HCl buffer solution as a reference standard for zero color.

D6.5.3 Multiply the absorbance by 1000 to obtain Milli absorbance unit (MAU).

D6.5.4 Calculation: calculate the concentration of sample solids in solution C from the RDS measured in section D6.4 convert the refractometer reading to brix from Annex G

D6.5.5 To allow for the concentration of the TEA/HCl buffer in the test solution, the measured RDS (Brix) must be multiplied by the factor 0.989 to give "Corrected RDS" (Brix) of the sample solid.

Use the corrected RDS to obtain the density, d in kg/m^3 of the test solution from ES 987 annex H The concentration of the test solution is given by:

$$C = \frac{(Corrected\ RDS)xd}{10^5} \text{ g/ml}$$

$$\text{ICUMSA color} = \frac{1000\,xAs}{bc}$$

Where

As = absorbance read

b = Length of the cell

c = Concentration of the sample solids

d = density of the test solution in kg/m^3

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Annex E

(normative)

Determination of conductivity ash

E1 Scope

This method specifies determination of conductivity ash of white sugars.

E2 Principle

The specific conductivity of a sugar solution of known concentration is determined then, by applying a constant factor the equivalent ash is calculated.

E3 Apparatus

E3.1 Conductivity meter

E3.2 Volumetric flasks 100, 500 and 1000 ml.

E3.3 Pipette 10 ml.

E3.4 Analytical balance

E4 Reagents

E4.1 Purified water with conductivity of less than 2 µS/cm

E4.2 Potassium chloride, 0.01M Dissolve 745.5 mg potassium chloride, preferably after dehydration by heating to 500 ^{o}c (dull red heat), in water in a 1 liter volumetric flask and make up to the mark.

E4.3 Potassium chloride, 0.0025M: add 250 ml of 0.01M potassium chloride solution to 1L flask and dilute by making up to the mark. This reference solution has a conductivity of 328 µS/cm at 20^{o}c.

E5 Procedure

E5.1 Weigh 28.0 g of white sugar in a beaker and add water until the total mass of sugar and water is 100.00 g. Dissolve the sugar.

E5.2 Transfer the solution in to the measuring cell and measure its conductivity at 20± 0.2^{o}c.

E5.3 Measure the conductivity of potassium chloride prepared in (Cr) E4.3 at 20 ^{o}c and determine the cell constant

$$= \frac{328}{Cr}$$

E5.4 if conductivity cannot be determined at the standard temperature of 20 ^{o}c make a temperature correction to the final result provided that the range of ±5^{o}c is not exceeded.

The correction is $C_{20}{}^{o}C = \frac{CT}{1 + 0.026(T - 20)}$

Where,

CT is the conductivity at temperature = T^{o}c

Or For each ^{0}C below 20^{o}c, add 2.6% and or for each ^{0}C above 20^{o}c, subtract 2.6%

E5.5 Calculation

If c_1 is the measured conductivity in µs/cm at 20^{o}c and

If c_2 is the specific conductivity of the water at 20^{o}c, then the correct conductivity (C_{28})of the 28 g/100g solution is

$C_{28} = C_1 - 0.35C_2$

Conductivity ash % = $6X10^{-4}X\ C_{28}$

Annex F
(normative)

Determination of sulphur dioxide

F1.Scope

This method is based on the colorimetric determination of sulphur dioxide and applicable to white sugars

F2. Principles

In the presence of formaldehyde, sugar solution containing sulphur dioxide reacts with rosaniline hydrochloride to form a colored complex which is measured at 560nm.

F3. Apparatus

F3.1 Spectrophotometer

F3.2 Beaker, 250ml

F3.3 Volumetric flasks, 100ml, 1000ml

F3.4 Test tube

F3.5 Pipettes 2, 10 and 25ml

F3.6 Burette 10ml graduated by 0.05ml

F3.7 Analytical balance readable to 0.1mg.

F4 Reagents

F4.1 Rosaniline hydrochloric solution (saturated)

Suspend 1g of rosaniline hydrochloride in100ml of distilled water heat to 50 ^{0}C and cool with shaking. After 48 hours filter the solution.

F4.2 Decolorized rosaniline solution

Transfer 4ml of the above saturated rosanline hydrochloride solution to a 100ml volumetric flask, add 6ml concentrated hydrochloric acid and make up to mark with distilled water. The solution is immediately decolorized. Allow to stand for at least 1 hour before use

F4.3 Formaldehyde solution (0.2g/100ml**)**. Dilute 5ml of a 40% formaldehyde solution to 1000ml**.**

F4.4 Pure sucrose solution. Dissolve 100g of analytical reagent grade sulphite -free sucrose in water and make up to 1000ml.

F4.5 Sodium hydroxide 0.1M

F4.6 Iodine solution 0.05M Dissolve 20g of analytical reagent grade iodate - free potassium iodide in 40ml of distilled water in a 1000 ml volumetric flask after add of 12.69 g of analytical reagent grade iodine shake the flask until all the iodine to dissolved and then make up to the mark with distilled water.

F4.7 Concentrated hydrochloric acid. 1.18g/ml

F4.8 Hydrochloric acid solution, 1M

F4.9 Iodine starch indicator.

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F4.10 Sodium thiosulphate solution 0.1M. Dissolve 24.817g of analytical grade of sodium thiosulphate pentahydrate in 200ml of distilled water in a 1000ml volumetric flask and then make up to the mark.

F4.11 Standard sulphite solution. Dissolve 2.5g sodium sulphite heptahydrate in sucrose solution (F4.4) and make up to 500ml with pure sucrose solution.

F4.11.1 Determine the titre of this solution as follows. Place 25ml of the 0.05 mol/L Iodine solution in a 300ml conical flask and add 10ml of the 1M hydrochloric acid solution followed by approximately 100ml of distilled water.

F4.11.2 Pipette 25ml of standard sulphite solution into this flask while swirling the flask.

F4.11.3 Titrat the excess iodine with the 0.1 mol/L sodium thiosulphate solution until the contents of the flask are a pale straw color. Then add the iodine indicator to the flask and continue the titration until the blue color disappears. Record the titre (t).

F4.12 Dilute standard sulphite solution. Dilute 5ml of standard suplhite solution (F4.11) to exactly 100ml with pure sucrose solution (F4.4). the exact value of the sulphite content C is calculated as follows from the titre t, found in (F4.11.3) above

$C = (25\text{-}t) \times 32.203 \times 2 \mu g\ SO_2/ml$

F5 Procedure

F5.1 Color development.

F5.1.1 Dissolve 10 to 40g of a sample of white sugar in distilled water in a 100ml volumetric flask. After addition of 4ml of 0.1M sodium hydroxide solution make the contents of the flask up to the mark and mix.

For levels 0 ----5 mg $S0_2$/kg use 40g of sample

5 ---15 mg $S0_2$/kg use 20g of sample

15—30 mg $S0_2$/kg use 10g of sample

F5.1.2 Transfer 10ml of aliquot to a clean, dry test tube. Add 2ml of decolorized rosaniline solution and 2ml of formaldehyde solution and allow the test tube to stand at room temperature for 30 minutes.

F5.1.3 Measure the absorbance in a 1cm cell in a spectrophotometer at 560nm using distilled water as a reference.

F5.2 Standard curve

F5.2.1 Pipettee aliquots of the dilute standard sulphite solution 0,1,2,4,5,6ml in to a series of 100ml volumetric flasks.

F5.2.2 Add to each flask, 4ml 0.1M sodium hydroxide and make up the volume to the mark with pure sucrose solution (F4.4) and mix.

F5.2.3 From each volumetric flask transfer 10ml aliquot to a clean, dry test tube. Add 2ml of decolorised rosaniline solution and 2ml of formaldehyde solution.

F5.2.4 Allow the tubes to stand at room temperature for 30min measure the absorbance in a 1cm cell at 560nm plot results on a graph.

F5.2.5 the amount of SO_2 in each test tube is

$$\frac{C \times n}{10} \mu g\ SO_2$$

Where

n = is the number of ml of dilute sulphate added to each 100ml flask and

c = is as calculated in F4.12

F5.3 Calculation

Calculate the concentration of sulphite by reference to the standard curve and express the result as mg SO_2/kg white sugar as follows:

$$\frac{\mu g\ SO_2 \text{ from graph} \times 10}{\text{Mass of sugar used for test.}} = \text{mg } SO_2\text{/kg sugar}$$

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Annex G
(normative)

Determination of copper atomic absorption Spectrophotometer method

1 Scope

This test method specifies the method specifies determination of copper in sugar and sugar products

2 Principles

Samples are wet ashed and after dilution are determined by atomic absorption at 324.7 nm Matrix of standard solution is matched to that of sample to avoid interference from Na and K

3 Apparatus

3.1 Atomic absorption spectrophotometer capable of measuring content or change of content of 0.05μg copper ml in aqueous solution

3.2 Volumetric flask 1000, and 50ml

3.3 Analytical balance

3.4 Hot plate

3.5 Beaker 400ml

4 Reagents

4.1 Nitric acid sp. 1.42

4.2 Perchloric acid

4.3 Copper purity 99.99%

5 Preparation of Standard solutions

5.1 Copper standard solution 1000μg/ml. Dissolve 1.000 g 99.99% Cu in 20 ml Nitric Acid cool and dilute to 1l with distilled water.

5.2 Matrix standard solutions : prepare solutions containing 0, 0.2, 0.4, 0.8, 1.6, 2.0, 4.0,8.0 , and 10μg Cu/ml and major metal matrix components to contain 700μg K, 70μg Na, 700μg Mg and 130μg Ca per milliliter with final HNO_3 ,concentration of (1+9)

6 Preparation of calibration curve

6.1 Stabilize and optimize conditions for the copper according to the manufacturers specifications

6.2 Aspirate 10μg/ml standard solution enough times to establish that absorbance reading is not drifting

6.3 Beginning with solution containing 0 μg Cu aspirate each matrix standard solution and record the absorbance. if the value of 10μg/ml solution differs from the average values of the previous reading repeat the measurements.

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Plot Absorbance against µg metal /ml for standard solutions prepared.

7. Procedure

7.1 Wet ashing

7.1.1 Accurately weigh 6 gm sample and transfer to 400 ml beaker ,add 100ml nitric acid and swirl .cover and let react for 10 minutes .

7.1.2 Place on hot plate .Evaporate to nearly dryness and cool.

7.1.3 Add 50 ml nitric acid and 10ml perchloric aid continue evaporation t obtain clear solution.

7.1.4 Carefully transfer to 50ml volumetric flask and dilute to volume with distilled water.

7.1.5 Prepare reagent blank containing the same amount of acids taken for the sample preparation, evaporate as above.

7.1.6 Photometry; Aspirate sample and blank solutions and record absorbance. Measure absorbance of matrix standard solution containing 10ml µg/ml. If the value differs from the average breading of the previous reading repeat the measurement . If these values indicate drift determine the cause, correct it repeat calibration sample and blank readings.

7.1.7 Calculations: correct readings of sample solution for blank. Convert corrected absorbance to µg/ml from the calibration curve.

Mg/Kg Cu= $\frac{CxV}{W}$

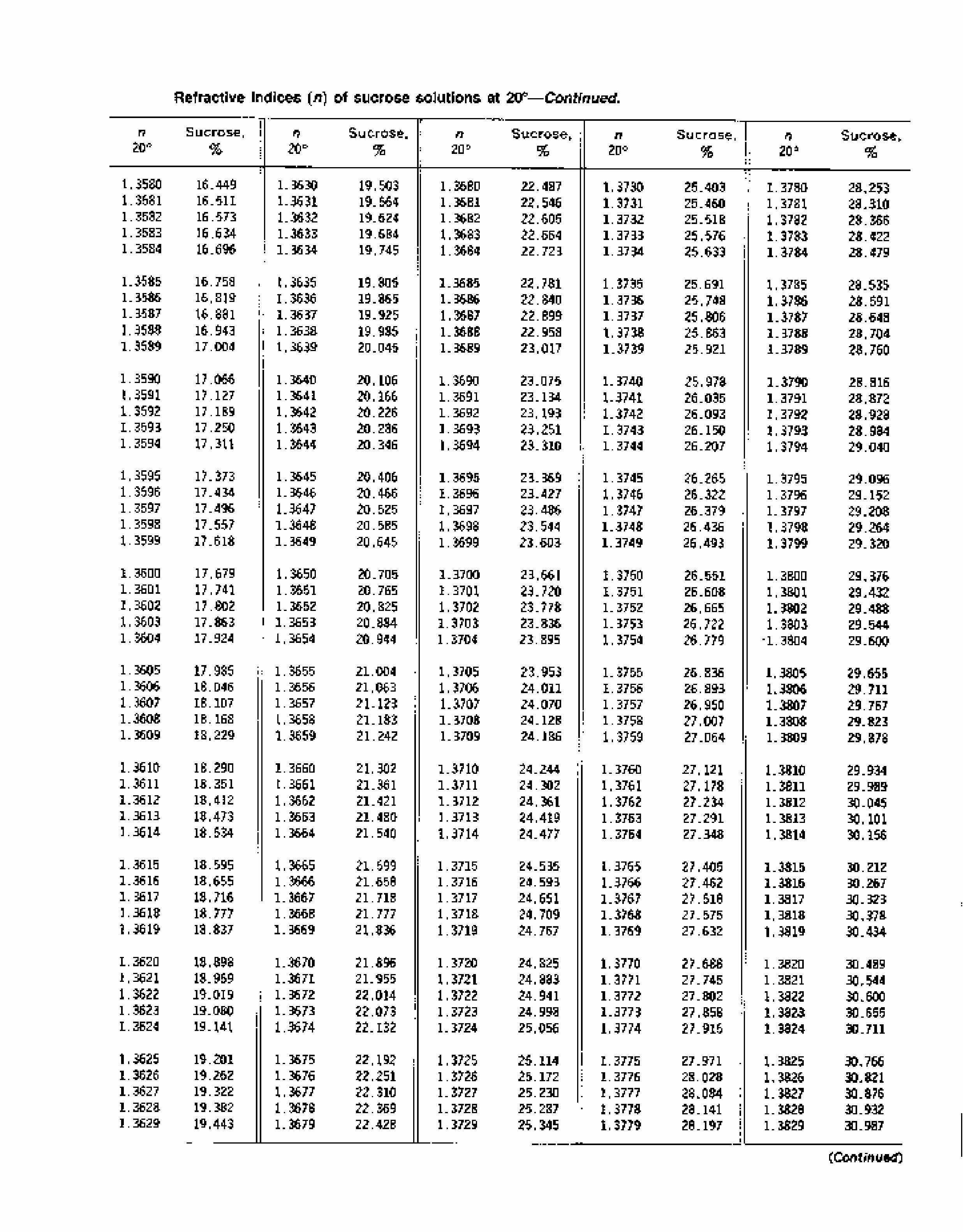
Where ,

C= Concentration of Cu In milligrams per liter read from the calibration curve

V= Final volume of sample solution

W= Weight of sample taken for the test

Annex G
(normative)



Refractive Indices (*n*) of sucrose solutions at 20°—*Continued.*

n 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %
1.3580	16.449	1.3630	19.503	1.3680	22.487	1.3730	25.403	1.3780	28.253
1.3581	16.511	1.3631	19.564	1.3681	22.546	1.3731	25.460	1.3781	28.310
1.3582	16.573	1.3632	19.624	1.3682	22.605	1.3732	25.518	1.3782	28.366
1.3583	16.634	1.3633	19.684	1.3683	22.664	1.3733	25.576	1.3783	28.422
1.3584	16.696	1.3634	19.745	1.3684	22.723	1.3734	25.633	1.3784	28.479
1.3585	16.758	1.3635	19.805	1.3685	22.781	1.3735	25.691	1.3785	28.535
1.3586	16.819	1.3636	19.865	1.3686	22.840	1.3736	25.748	1.3786	28.591
1.3587	16.881	1.3637	19.925	1.3687	22.899	1.3737	25.806	1.3787	28.648
1.3588	16.943	1.3638	19.985	1.3688	22.958	1.3738	25.863	1.3788	28.704
1.3589	17.004	1.3639	20.045	1.3689	23.017	1.3739	25.921	1.3789	28.760
1.3590	17.066	1.3640	20.106	1.3690	23.075	1.3740	25.978	1.3790	28.816
1.3591	17.127	1.3641	20.166	1.3691	23.134	1.3741	26.035	1.3791	28.872
1.3592	17.189	1.3642	20.226	1.3692	23.193	1.3742	26.093	1.3792	28.928
1.3593	17.250	1.3643	20.286	1.3693	23.251	1.3743	26.150	1.3793	28.984
1.3594	17.311	1.3644	20.346	1.3694	23.310	1.3744	26.207	1.3794	29.040
1.3595	17.373	1.3645	20.406	1.3695	23.369	1.3745	26.265	1.3795	29.096
1.3596	17.434	1.3646	20.466	1.3696	23.427	1.3746	26.322	1.3796	29.152
1.3597	17.496	1.3647	20.525	1.3697	23.486	1.3747	26.379	1.3797	29.208
1.3598	17.557	1.3648	20.585	1.3698	23.544	1.3748	26.436	1.3798	29.264
1.3599	17.618	1.3649	20.645	1.3699	23.603	1.3749	26.493	1.3799	29.320
1.3600	17.679	1.3650	20.705	1.3700	23.661	1.3750	26.551	1.3800	29.376
1.3601	17.741	1.3651	20.765	1.3701	23.720	1.3751	26.608	1.3801	29.432
1.3602	17.802	1.3652	20.825	1.3702	23.778	1.3752	26.665	1.3802	29.488
1.3603	17.863	1.3653	20.884	1.3703	23.836	1.3753	26.722	1.3803	29.544
1.3604	17.924	1.3654	20.944	1.3704	23.895	1.3754	26.779	1.3804	29.600
1.3605	17.985	1.3655	21.004	1.3705	23.953	1.3755	26.836	1.3805	29.655
1.3606	18.046	1.3656	21.063	1.3706	24.011	1.3756	26.893	1.3806	29.711
1.3607	18.107	1.3657	21.123	1.3707	24.070	1.3757	26.950	1.3807	29.767
1.3608	18.168	1.3658	21.183	1.3708	24.128	1.3758	27.007	1.3808	29.823
1.3609	18.229	1.3659	21.242	1.3709	24.186	1.3759	27.064	1.3809	29.878
1.3610	18.290	1.3660	21.302	1.3710	24.244	1.3760	27.121	1.3810	29.934
1.3611	18.351	1.3661	21.361	1.3711	24.302	1.3761	27.178	1.3811	29.989
1.3612	18.412	1.3662	21.421	1.3712	24.361	1.3762	27.234	1.3812	30.045
1.3613	18.473	1.3663	21.480	1.3713	24.419	1.3763	27.291	1.3813	30.101
1.3614	18.534	1.3664	21.540	1.3714	24.477	1.3764	27.348	1.3814	30.156
1.3615	18.595	1.3665	21.599	1.3715	24.535	1.3765	27.405	1.3815	30.212
1.3616	18.655	1.3666	21.658	1.3716	24.593	1.3766	27.462	1.3816	30.267
1.3617	18.716	1.3667	21.718	1.3717	24.651	1.3767	27.518	1.3817	30.323
1.3618	18.777	1.3668	21.777	1.3718	24.709	1.3768	27.575	1.3818	30.378
1.3619	18.837	1.3669	21.836	1.3719	24.767	1.3769	27.632	1.3819	30.434
1.3620	18.898	1.3670	21.896	1.3720	24.825	1.3770	27.688	1.3820	30.489
1.3621	18.959	1.3671	21.955	1.3721	24.883	1.3771	27.745	1.3821	30.544
1.3622	19.019	1.3672	22.014	1.3722	24.941	1.3772	27.802	1.3822	30.600
1.3623	19.080	1.3673	22.073	1.3723	24.998	1.3773	27.858	1.3823	30.655
1.3624	19.141	1.3674	22.132	1.3724	25.056	1.3774	27.915	1.3824	30.711
1.3625	19.201	1.3675	22.192	1.3725	25.114	1.3775	27.971	1.3825	30.766
1.3626	19.262	1.3676	22.251	1.3726	25.172	1.3776	28.028	1.3826	30.821
1.3627	19.322	1.3677	22.310	1.3727	25.230	1.3777	28.084	1.3827	30.876
1.3628	19.382	1.3678	22.369	1.3728	25.287	1.3778	28.141	1.3828	30.932
1.3629	19.443	1.3679	22.428	1.3729	25.345	1.3779	28.197	1.3829	30.987

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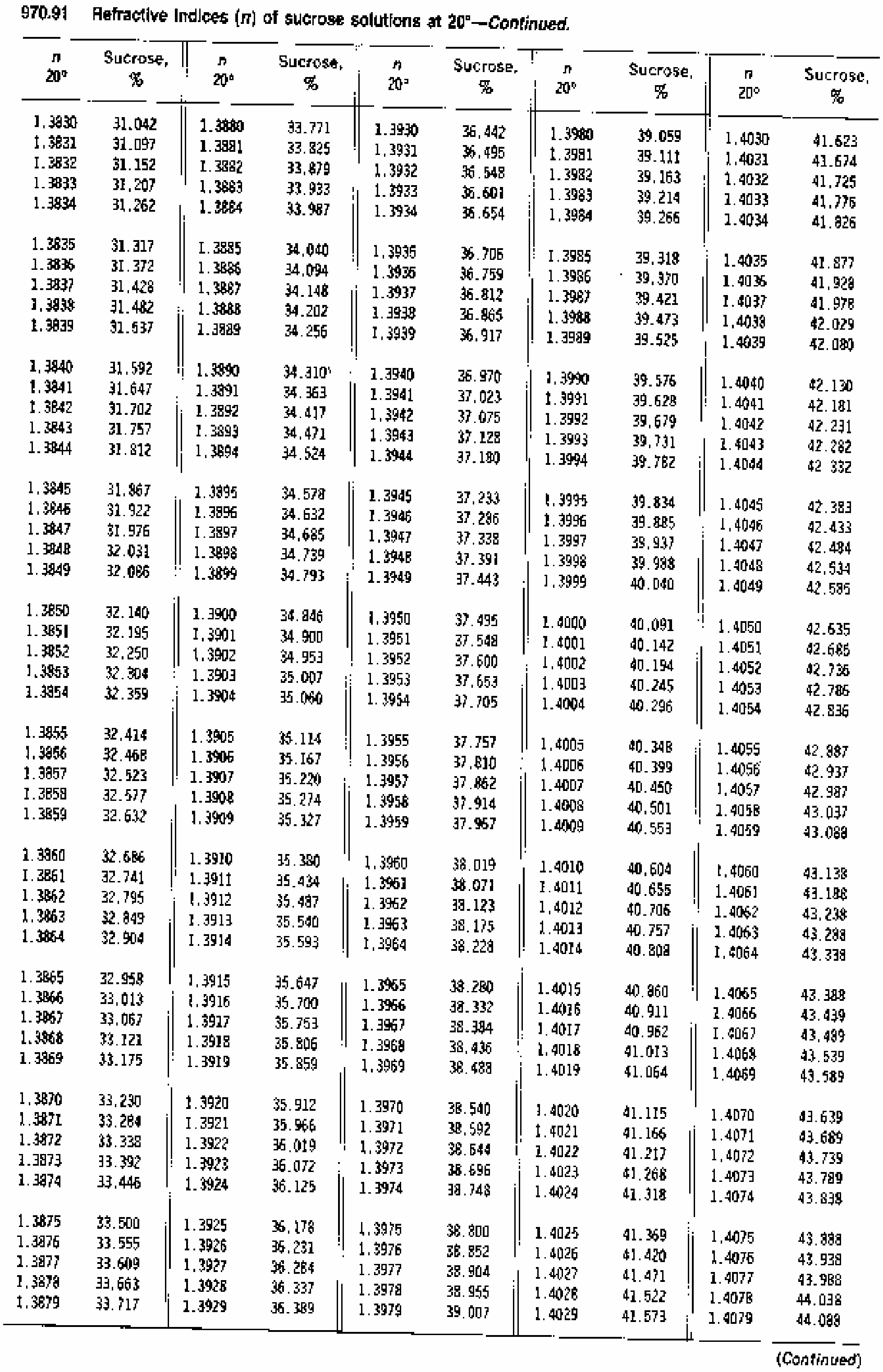

970.91 Refractive Indices (n) of sucrose solutions at 20°—*Continued.*

n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %
1.3830	31.042	1.3880	33.771	1.3930	36.442	1.3980	39.059	1.4030	41.623
1.3831	31.097	1.3881	33.825	1.3931	36.495	1.3981	39.111	1.4031	41.674
1.3832	31.152	1.3882	33.879	1.3932	36.548	1.3982	39.163	1.4032	41.725
1.3833	31.207	1.3883	33.933	1.3933	36.601	1.3983	39.214	1.4033	41.776
1.3834	31.262	1.3884	33.987	1.3934	36.654	1.3984	39.266	1.4034	41.826
1.3835	31.317	1.3885	34.040	1.3935	36.706	1.3985	39.318	1.4035	41.877
1.3836	31.372	1.3886	34.094	1.3936	36.759	1.3986	39.370	1.4036	41.928
1.3837	31.428	1.3887	34.148	1.3937	36.812	1.3987	39.421	1.4037	41.978
1.3838	31.482	1.3888	34.202	1.3938	36.865	1.3988	39.473	1.4038	42.029
1.3839	31.537	1.3889	34.256	1.3939	36.917	1.3989	39.525	1.4039	42.080
1.3840	31.592	1.3890	34.310	1.3940	36.970	1.3990	39.576	1.4040	42.130
1.3841	31.647	1.3891	34.363	1.3941	37.023	1.3991	39.628	1.4041	42.181
1.3842	31.702	1.3892	34.417	1.3942	37.075	1.3992	39.679	1.4042	42.231
1.3843	31.757	1.3893	34.471	1.3943	37.128	1.3993	39.731	1.4043	42.282
1.3844	31.812	1.3894	34.524	1.3944	37.180	1.3994	39.782	1.4044	42.332
1.3845	31.867	1.3895	34.578	1.3945	37.233	1.3995	39.834	1.4045	42.383
1.3846	31.922	1.3896	34.632	1.3946	37.286	1.3996	39.885	1.4046	42.433
1.3847	31.976	1.3897	34.685	1.3947	37.338	1.3997	39.937	1.4047	42.484
1.3848	32.031	1.3898	34.739	1.3948	37.391	1.3998	39.988	1.4048	42.534
1.3849	32.086	1.3899	34.793	1.3949	37.443	1.3999	40.040	1.4049	42.585
1.3850	32.140	1.3900	34.846	1.3950	37.495	1.4000	40.091	1.4050	42.635
1.3851	32.195	1.3901	34.900	1.3951	37.548	1.4001	40.142	1.4051	42.685
1.3852	32.250	1.3902	34.953	1.3952	37.600	1.4002	40.194	1.4052	42.736
1.3853	32.304	1.3903	35.007	1.3953	37.653	1.4003	40.245	1 4053	42.786
1.3854	32.359	1.3904	35.060	1.3954	37.705	1.4004	40.296	1.4054	42.836
1.3855	32.414	1.3905	35.114	1.3955	37.757	1.4005	40.348	1.4055	42.887
1.3856	32.468	1.3906	35.167	1.3956	37.810	1.4006	40.399	1.4056	42.937
1.3857	32.523	1.3907	35.220	1.3957	37.862	1.4007	40.450	1.4057	42.987
1.3858	32.577	1.3908	35.274	1.3958	37.914	1.4008	40.501	1.4058	43.037
1.3859	32.632	1.3909	35.327	1.3959	37.967	1.4009	40.553	1.4059	43.088
1.3860	32.686	1.3910	35.380	1.3960	38.019	1.4010	40.604	1.4060	43.138
1.3861	32.741	1.3911	35.434	1.3961	38.071	1.4011	40.655	1.4061	43.188
1.3862	32.795	1.3912	35.487	1.3962	38.123	1.4012	40.706	1.4062	43.238
1.3863	32.849	1.3913	35.540	1.3963	38.175	1.4013	40.757	1.4063	43.288
1.3864	32.904	1.3914	35.593	1.3964	38.228	1.4014	40.808	1.4064	43.338
1.3865	32.958	1.3915	35.647	1.3965	38.280	1.4015	40.860	1.4065	43.388
1.3866	33.013	1.3916	35.700	1.3966	38.332	1.4016	40.911	1.4066	43.439
1.3867	33.067	1.3917	35.753	1.3967	38.384	1.4017	40.962	1.4067	43.489
1.3868	33.121	1.3918	35.806	1.3968	38.436	1.4018	41.013	1.4068	43.539
1.3869	33.175	1.3919	35.859	1.3969	38.488	1.4019	41.064	1.4069	43.589
1.3870	33.230	1.3920	35.912	1.3970	38.540	1.4020	41.115	1.4070	43.639
1.3871	33.284	1.3921	35.966	1.3971	38.592	1.4021	41.166	1.4071	43.689
1.3872	33.338	1.3922	36.019	1.3972	38.644	1.4022	41.217	1.4072	43.739
1.3873	33.392	1.3923	36.072	1.3973	38.696	1.4023	41.268	1.4073	43.789
1.3874	33.446	1.3924	36.125	1.3974	38.748	1.4024	41.318	1.4074	43.838
1.3875	33.500	1.3925	36.178	1.3975	38.800	1.4025	41.369	1.4075	43.888
1.3876	33.555	1.3926	36.231	1.3976	38.852	1.4026	41.420	1.4076	43.938
1.3877	33.609	1.3927	36.284	1.3977	38.904	1.4027	41.471	1.4077	43.988
1.3878	33.663	1.3928	36.337	1.3978	38.955	1.4028	41.522	1.4078	44.038
1.3879	33.717	1.3929	36.389	1.3979	39.007	1.4029	41.573	1.4079	44.088

(Continued)

Refractive Indices (*n*) of sucrose solutions at 20°—*Continued.*

n 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %
1.4080	44.138	1.4130	46.604	1.4180	49.023	1.4230	51.399	1.4280	53.733
1.4081	44.187	1.4131	46.652	1.4181	49.071	1.4231	51.446	1.4281	53.779
1.4082	44.237	1.4132	46.701	1.4182	49.119	1.4232	51.493	1.4282	53.825
1.4083	44.287	1.4133	46.750	1.4183	49.167	1.4233	51.540	1.4283	53.871
1.4084	44.337	1.4134	46.799	1.4184	49.215	1.4234	51.587	1.4284	53.918
1.4085	44.386	1.4135	46.848	1.4185	49.263	1.4235	51.634	1.4285	53.964
1.4086	44.436	1.4136	46.896	1.4186	49.311	1.4236	51.681	1.4286	54.010
1.4087	44.486	1.4137	46.945	1.4187	49.359	1.4237	51.728	1.4287	54.056
1.4088	44.535	1.4138	46.994	1.4188	49.407	1.4238	51.775	1.4288	54.102
1.4089	44.585	1.4139	47.043	1.4189	49.454	1.4239	51.822	1.4289	54.148
1.4090	44.635	1.4140	47.091	1.4190	49.502	1.4240	51.869	1.4290	54.194
1.4091	44.684	1.4141	47.140	1.4191	49.550	1.4241	51.916	1.4291	54.241
1.4092	44.734	1.4142	47.188	1.4192	49.598	1.4242	51.963	1.4292	54.287
1.4093	44.783	1.4143	47.237	1.4193	49.645	1.4243	52.010	1.4293	54.333
1.4094	44.833	1.4144	47.286	1.4194	49.693	1.4244	52.057	1.4294	54.379
1.4095	44.882	1.4145	47.334	1.4195	49.741	1.4245	52.104	1.4295	54.425
1.4096	44.932	1.4146	47.383	1.4196	49.788	1.4246	52.150	1.4296	54.471
1.4097	44.981	1.4147	47.431	1.4197	49.836	1.4247	52.197	1.4297	54.517
1.4098	45.031	1.4148	47.480	1.4198	49.884	1.4248	52.244	1.4298	54.563
1.4099	45.080	1.4149	47.528	1.4199	49.931	1.4249	52.291	1.4299	54.609
1.4100	45.130	1.4150	47.577	1.4200	49.979	1.4250	52.338	1.4300	54.655
1.4101	45.179	1.4151	47.625	1.4201	50.027	1.4251	52.384	1.4301	54.701
1.4102	45.228	1.4152	47.674	1.4202	50.074	1.4252	52.431	1.4302	54.746
1.4103	45.278	1.4153	47.722	1.4203	50.122	1.4253	52.478	1.4303	54.792
1.4104	45.327	1.4154	47.771	1.4204	50.169	1.4254	52.524	1.4304	54.838
1.4105	45.376	1.4155	47.819	1.4205	50.217	1.4255	52.571	1.4305	54.884
1.4106	45.426	1.4156	47.868	1.4206	50.264	1.4256	52.618	1.4306	54.930
1.4107	45.475	1.4157	47.916	1.4207	50.312	1.4257	52.664	1.4307	54.976
1.4108	45.524	1.4158	47.964	1.4208	50.359	1.4258	52.711	1.4308	55.022
1.4109	45.574	1.4159	48.013	1.4209	50.407	1.4259	52.758	1.4309	55.067
1.4110	45.623	1.4160	48.061	1.4210	50.454	1.4260	52.804	1.4310	55.113
1.4111	45.672	1.4161	48.109	1.4211	50.502	1.4261	52.851	1.4311	55.159
1.4112	45.721	1.4162	48.158	1.4212	50.549	1.4262	52.897	1.4312	55.205
1.4113	45.770	1.4163	48.206	1.4213	50.596	1.4263	52.944	1.4313	55.250
1.4114	45.820	1.4164	48.254	1.4214	50.644	1.4264	52.990	1.4314	55.296
1.4115	45.869	1.4165	48.302	1.4215	50.691	1.4265	53.037	1.4315	55.342
1.4116	45.918	1.4166	48.350	1.4216	50.738	1.4266	53.083	1.4316	55.388
1.4117	45.967	1.4167	48.399	1.4217	50.786	1.4267	53.130	1.4317	55.433
1.4118	46.016	1.4168	48.447	1.4218	50.833	1.4268	53.176	1.4318	55.479
1.4119	46.065	1.4169	48.495	1.4219	50.880	1.4269	53.223	1.4319	55.524
1.4120	46.114	1.4170	48.543	1.4220	50.928	1.4270	53.269	1.4320	55.570
1.4121	46.163	1.4171	48.591	1.4221	50.975	1.4271	53.316	1.4321	55.616
1.4122	46.212	1.4172	48.639	1.4222	51.022	1.4272	53.362	1.4322	55.661
1.4123	46.261	1.4173	48.687	1.4223	51.069	1.4273	53.408	1.4323	55.707
1.4124	46.310	1.4174	48.735	1.4224	51.116	1.4274	53.455	1.4324	55.752
1.4125	46.359	1.4175	48.784	1.4225	51.164	1.4275	53.501	1.4325	55.797
1.4126	46.408	1.4176	48.832	1.4226	51.211	1.4276	53.548	1.4326	55.844
1.4127	46.457	1.4177	48.680	1.4227	51.258	1.4277	53.594	1.4327	55.889
1.4128	46.506	1.4178	48.928	1.4228	51.305	1.4278	53.640	1.4328	55.935
1.4129	46.555	1.4179	48.976	1.4229	51.352	1.4279	53.686	1.4329	55.980

(Continued)

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Refractive indices (n) of sucrose solutions at 20°—*Continued.*

n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %
1.4330	56.026	1.4380	58.279	1.4430	60.496	1.4480	62.677	1.4530	64.823
1.4331	56.071	1.4381	58.324	1.4431	60.540	1.4481	62.720	1.4531	64.865
1.4332	56.116	1.4382	58.369	1.4432	60.584	1.4482	62.763	1.4532	64.908
1.4333	56.162	1.4383	58.413	1.4433	60.628	1.4483	62.806	1.4533	64.950
1.4334	56.207	1.4384	58.458	1.4434	60.672	1.4484	62.849	1.4534	64.993
1.4335	56.253	1.4385	58.503	1.4435	60.716	1.4485	62.893	1.4535	65.035
1.4336	56.298	1.4386	58.547	1.4436	60.759	1.4486	62.936	1.4536	65.078
1.4337	56.343	1.4387	58.592	1.4437	60.803	1.4487	62.979	1.4537	65.120
1.4338	56.389	1.4388	58.637	1.4438	60.847	1.4488	63.022	1.4538	65.163
1.4339	56.434	1.4389	58.681	1.4439	60.891	1.4489	63.065	1.4539	65.205
1.4340	56.479	1.4390	58.726	1.4440	60.935	1.4490	63.108	1.4540	65.248
1.4341	56.525	1.4391	58.770	1.4441	60.979	1.4491	63.152	1.4541	65.290
1.4342	56.570	1.4392	58.815	1.4442	61.023	1.4492	63.195	1.4542	65.333
1.4343	56.615	1.4393	58.859	1.4443	61.066	1.4493	63.238	1.4543	65.375
1.4344	56.660	1.4394	58.904	1.4444	61.110	1.4494	63.281	1.4544	65.417
1.4345	56.706	1.4395	58.948	1.4445	61.154	1.4495	63.324	1.4545	65.460
1.4346	56.751	1.4396	58.993	1.4446	61.198	1.4496	63.367	1.4546	65.502
1.4347	56.796	1.4397	59.037	1.4447	61.241	1.4497	63.410	1.4547	65.544
1.4348	56.841	1.4398	59.082	1.4448	61.285	1.4498	63.453	1.4548	65.587
1.4349	56.887	1.4399	59.126	1.4449	61.329	1.4499	63.496	1.4549	65.629
1.4350	56.932	1.4400	59.170	1.4450	61.372	1.4500	63.539	1.4550	65.672
1.4351	56.977	1.4401	59.215	1.4451	61.416	1.4501	63.582	1.4551	65.714
1.4352	57.022	1.4402	59.259	1.4452	61.460	1.4502	63.625	1.4552	65.756
1.4353	57.067	1.4403	59.304	1.4453	61.503	1.4503	63.668	1.4553	65.798
1.4354	57.112	1.4404	59.348	1.4454	61.547	1.4504	63.711	1.4554	65.841
1.4355	57.157	1.4405	59.392	1.4455	61.591	1.4505	63.754	1.4555	65.883
1.4356	57.202	1.4406	59.437	1.4456	61.634	1.4506	63.797	1.4556	65.925
1.4357	57.247	1.4407	59.481	1.4457	61.678	1.4507	63.840	1.4557	65.967
1.4358	57.292	1.4408	59.525	1.4458	61.721	1.4508	63.882	1.4558	66.010
1.4359	57.337	1.4409	59.569	1.4459	61.765	1.4509	63.925	1.4559	66.052
1.4360	57.382	1.4410	59.614	1.4460	61.809	1.4510	63.968	1.4560	66.094
1.4361	57.427	1.4411	59.658	1.4461	61.852	1.4511	64.011	1.4561	66.136
1.4362	57.472	1.4412	59.702	1.4462	61.896	1.4512	64.054	1.4562	66.178
1.4363	57.517	1.4413	59.746	1.4463	61.939	1.4513	64.097	1.4563	66.221
1.4364	57.562	1.4414	59.791	1.4464	61.983	1.4514	64.139	1.4564	66.263
1.4365	57.607	1.4415	59.835	1.4465	62.026	1.4515	64.182	1.4565	66.305
1.4366	57.652	1.4416	59.879	1.4466	62.070	1.4516	64.225	1.4566	66.347
1.4367	57.697	1.4417	59.923	1.4467	62.113	1.4517	64.268	1.4567	66.389
1.4368	57.742	1.4418	59.967	1.4468	62.156	1.4518	64.311	1.4568	66.431
1.4369	57.787	1.4419	60.011	1.4469	62.200	1.4519	64.353	1.4569	66.473
1.4370	57.832	1.4420	60.056	1.4470	62.243	1.4520	64.396	1.4570	66.515
1.4371	57.877	1.4421	60.100	1.4471	62.287	1.4521	64.439	1.4571	66.557
1.4372	57.921	1.4422	60.144	1.4472	62.330	1.4522	64.481	1.4572	66.599
1.4373	57.966	1.4423	60.188	1.4473	62.373	1.4523	64.524	1.4573	66.641
1.4374	58.011	1.4424	60.232	1.4474	62.417	1.4524	64.567	1.4574	66.683
1.4375	58.056	1.4425	60.276	1.4475	62.460	1.4525	64.609	1.4575	66.725
1.4376	58.101	1.4426	60.320	1.4476	62.503	1.4526	64.652	1.4576	66.767
1.4377	58.145	1.4427	60.364	1.4477	62.547	1.4527	64.695	1.4577	66.809
1.4378	58.190	1.4428	60.408	1.4478	62.590	1.4528	64.737	1.4578	66.851
1.4379	58.235	1.4429	60.452	1.4479	62.633	1.4529	64.780	1.4579	66.893

(Continued)

Refractive Indices (*n*) of sucrose solutions at 20°—*Continued*.

n 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %
1.4580	66.935	1.4630	69.016	1.4680	71.065	1.4730	73.084	1.4780	75.074
1.4581	66.977	1.4631	69.057	1.4681	71.106	1.4731	73.124	1.4781	75.114
1.4582	67.019	1.4632	69.098	1.4682	71.146	1.4732	73.164	1.4782	75.153
1.4583	67.061	1.4633	69.139	1.4683	71.187	1.4733	73.204	1.4783	75.193
1.4584	67.103	1.4634	69.181	1.4684	71.228	1.4734	73.244	1.4784	75.232
1.4585	67.145	1.4635	69.222	1.4685	71.268	1.4735	73.285	1.4785	75.272
1.4586	67.186	1.4636	69.263	1.4686	71.309	1.4736	73.325	1.4786	75.311
1.4587	67.228	1.4637	69.304	1.4687	71.349	1.4737	73.365	1.4787	75.350
1.4588	67.270	1.4638	69.346	1.4688	71.390	1.4738	73.405	1.4788	75.390
1.4589	67.312	1.4639	69.387	1.4689	71.431	1.4739	73.445	1.4789	75.429
1.4590	67.354	1.4640	69.428	1.4690	71.471	1.4740	73.485	1.4790	75.469
1.4591	67.396	1.4641	69.469	1.4691	71.512	1.4741	73.524	1.4791	75.508
1.4592	67.437	1.4642	69.510	1.4692	71.552	1.4742	73.564	1.4792	75.547
1.4593	67.479	1.4643	69.551	1.4693	71.593	1.4743	73.604	1.4793	75.587
1.4594	67.521	1.4644	69.593	1.4694	71.633	1.4744	73.644	1.4794	75.626
1.4595	67.563	1.4645	69.634	1.4695	71.674	1.4745	73.684	1.4795	75.666
1.4596	67.604	1.4646	69.675	1.4696	71.714	1.4746	73.724	1.4796	75.705
1.4597	67.646	1.4647	69.716	1.4697	71.755	1.4747	73.764	1.4797	75.744
1.4598	67.688	1.4648	69.757	1.4698	71.795	1.4748	73.804	1.4798	75.784
1.4599	67.729	1.4649	69.798	1.4699	71.836	1.4749	73.844	1.4799	75.823
1.4600	67.771	1.4650	69.839	1.4700	71.876	1.4750	73.884	1.4800	75.862
1.4601	67.813	1.4651	69.880	1.4701	71.917	1.4751	73.924	1.4801	75.901
1.4602	67.854	1.4652	69.921	1.4702	71.957	1.4752	73.963	1.4802	75.941
1.4603	67.896	1.4653	69.962	1.4703	71.998	1.4753	74.003	1.4803	75.980
1.4604	67.938	1.4654	70.003	1.4704	72.038	1.4754	74.043	1.4804	76.019
1.4605	67.979	1.4655	70.044	1.4705	72.078	1.4755	74.083	1.4805	76.058
1.4606	68.021	1.4656	70.085	1.4706	72.119	1.4756	74.123	1.4806	76.098
1.4607	68.063	1.4657	70.126	1.4707	72.159	1.4757	74.162	1.4807	76.137
1.4608	68.104	1.4658	70.167	1.4708	72.199	1.4758	74.202	1.4808	76.176
1.4609	68.146	1.4659	70.208	1.4709	72.240	1.4759	74.242	1.4809	76.215
1.4610	68.187	1.4660	70.249	1.4710	72.280	1.4760	74.282	1.4810	76.254
1.4611	68.229	1.4661	70.290	1.4711	72.320	1.4761	74.321	1.4811	76.294
1.4612	68.270	1.4662	70.331	1.4712	72.361	1.4762	74.361	1.4812	76.333
1.4613	68.312	1.4663	70.372	1.4713	72.401	1.4763	74.401	1.4813	76.372
1.4614	68.353	1.4664	70.413	1.4714	72.441	1.4764	74.441	1.4814	76.411
1.4615	68.395	1.4665	70.453	1.4715	72.482	1.4765	74.480	1.4815	76.450
1.4616	68.436	1.4666	70.494	1.4716	72.522	1.4766	74.520	1.4816	76.489
1.4617	68.478	1.4667	70.535	1.4717	72.562	1.4767	74.560	1.4817	76.528
1.4618	68.519	1.4668	70.576	1.4718	72.602	1.4768	74.599	1.4818	76.567
1.4619	68.561	1.4669	70.617	1.4719	72.643	1.4769	74.639	1.4819	76.607
1.4620	68.602	1.4670	70.658	1.4720	72.683	1.4770	74.678	1.4820	76.646
1.4621	68.643	1.4671	70.698	1.4721	72.723	1.4771	74.718	1.4821	76.685
1.4622	68.685	1.4672	70.739	1.4722	72.763	1.4772	74.758	1.4822	76.724
1.4623	68.726	1.4673	70.780	1.4723	72.803	1.4773	74.797	1.4823	76.763
1.4624	68.768	1.4674	70.821	1.4724	72.843	1.4774	74.837	1.4824	76.802
1.4625	68.809	1.4675	70.861	1.4725	72.884	1.4775	74.876	1.4825	76.841
1.4626	68.850	1.4676	70.902	1.4726	72.924	1.4776	74.916	1.4826	76.880
1.4627	68.892	1.4677	70.943	1.4727	72.964	1.4777	74.956	1.4827	76.919
1.4628	68.933	1.4678	70.984	1.4728	73.004	1.4778	74.995	1.4828	76.958
1.4629	68.974	1.4679	71.024	1.4729	73.044	1.4779	75.035	1.4829	76.997

(*Continued*)

970.91 Refractive indices (*n*) of sucrose solutions at 20°—*Concluded.*

n 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %
1.4830	77.036	1.4880	78.969	1.4930	80.876	1.4980	82.755	1.5030	84.609
1.4831	77.075	1.4881	79.008	1.4931	80.913	1.4981	82.793	1.5031	84.645
1.4832	77.113	1.4882	79.046	1.4932	80.951	1.4982	82.830	1.5032	84.682
1.4833	77.152	1.4883	79.084	1.4933	80.989	1.4983	82.867	1.5033	84.719
1.4834	77.191	1.4884	79.123	1.4934	81.027	1.4984	82.905	1.5034	84.756
1.4835	77.230	1.4885	79.161	1.4935	81.065	1.4985	82.942	1.5035	84.792
1.4836	77.269	1.4886	79.199	1.4936	81.103	1.4986	82.979	1.5036	84.829
1.4837	77.308	1.4887	79.238	1.4937	81.140	1.4987	83.016	1.5037	84.866
1.4838	77.347	1.4888	79.276	1.4938	81.178	1.4988	83.054	1.5038	84.903
1.4839	77.386	1.4889	79.314	1.4939	81.216	1.4989	83.091	1.5039	84.939
1.4840	77.425	1.4890	79.353	1.4940	81.254	1.4990	83.128	1.5040	84.976
1.4841	77.463	1.4891	79.391	1.4941	81.291	1.4991	83.165	1.5041	85.013
1.4842	77.502	1.4892	79.429	1.4942	81.329	1.4992	83.202	1.5042	85.049
1.4843	77.541	1.4893	79.468	1.4943	81.367	1.4993	83.240	1.5043	85.086
1.4844	77.580	1.4894	79.506	1.4944	81.405	1.4994	83.277	1.5044	85.123
1.4845	77.619	1.4895	79.544	1.4945	81.442	1.4995	83.314	1.5045	85.159
1.4846	77.657	1.4896	79.582	1.4946	81.480	1.4996	83.351	1.5046	85.196
1.4847	77.696	1.4897	79.620	1.4947	81.518	1.4997	83.388	1.5047	85.233
1.4848	77.735	1.4898	79.659	1.4948	81.555	1.4998	83.425	1.5048	85.269
1.4849	77.774	1.4899	79.697	1.4949	81.593	1.4999	83.463	1.5049	85.306
1.4850	77.812	1.4900	79.735	1.4950	81.631	1.5000	83.500	1.5050	85.343
1.4851	77.851	1.4901	79.773	1.4951	81.668	1.5001	83.537	1.5051	85.379
1.4852	77.890	1.4902	79.811	1.4952	81.706	1.5002	83.574	1.5052	85.416
1.4853	77.928	1.4903	79.850	1.4953	81.744	1.5003	83.611	1.5053	85.452
1.4854	77.967	1.4904	79.888	1.4954	81.781	1.5004	83.648	1.5054	85.489
1.4855	78.006	1.4905	79.926	1.4955	81.819	1.5005	83.685	1.5055	85.525
1.4856	78.045	1.4906	79.964	1.4956	81.856	1.5006	83.722	1.5056	85.562
1.4857	78.083	1.4907	80.002	1.4957	81.894	1.5007	83.759	1.5057	85.598
1.4858	78.122	1.4908	80.040	1.4958	81.932	1.5008	83.796	1.5058	85.635
1.4859	78.160	1.4909	80.078	1.4959	81.969	1.5009	83.833	1.5059	85.672
1.4860	78.199	1.4910	80.116	1.4960	82.007	1.5010	83.870	1.5060	85.708
1.4861	78.238	1.4911	80.154	1.4961	82.044	1.5011	83.907	1.5061	85.744
1.4862	78.276	1.4912	80.192	1.4962	82.082	1.5012	83.944	1.5062	85.781
1.4863	78.315	1.4913	80.231	1.4963	82.119	1.5013	83.981	1.5063	85.817
1.4864	78.353	1.4914	80.269	1.4964	82.157	1.5014	84.018	1.5064	85.854
1.4865	78.392	1.4915	80.307	1.4965	82.194	1.5015	84.055	1.5065	85.890
1.4866	78.431	1.4916	80.345	1.4966	82.232	1.5016	84.092	1.5066	85.927
1.4867	78.469	1.4917	80.383	1.4967	82.269	1.5017	84.129	1.5067	85.963
1.4868	78.508	1.4918	80.421	1.4968	82.307	1.5018	84.166	1.5068	86.000
1.4869	78.546	1.4919	80.459	1.4969	82.344	1.5019	84.203	1.5069	86.036
1.4870	78.585	1.4920	80.497	1.4970	82.381	1.5020	84.240	1.5070	86.072
1.4871	78.623	1.4921	80.534	1.4971	82.419	1.5021	84.277	1.5071	86.109
1.4872	78.662	1.4922	80.572	1.4972	82.456	1.5022	84.314	1.5072	86.145
1.4873	78.700	1.4923	80.610	1.4973	82.494	1.5023	84.351	1.5073	86.182
1.4874	78.739	1.4924	80.648	1.4974	82.531	1.5024	84.388	1.5074	86.218
1.4875	78.777	1.4925	80.686	1.4975	82.569	1.5025	84.424	1.5075	86.254
1.4876	78.816	1.4926	80.724	1.4976	82.606	1.5026	84.461	1.5076	86.291
1.4877	78.854	1.4927	80.762	1.4977	82.643	1.5027	84.498	1.5077	86.327
1.4878	78.892	1.4928	80.800	1.4978	82.681	1.5028	84.535	1.5078	86.363
1.4879	78.931	1.4929	80.838	1.4979	82.718	1.5029	84.572	1.5079	86.399

Table for determining per cent sucrose in sugar solutions from readings of Zeiss immersion refractometer at 20°C[a]

Reading[b] at 20°	n_D^{20}	Sucrose, %	Reading[b] at 20°	n_D^{20}	Sucrose, %	Reading[b] at 20°	n_D^{20}	Sucrose, %
14.47	1.33299	0	45	1.34463	7.91	76	1.35606	15.24
15	3320	0.15	46	4500	8.15	77	5642	15.47
16	3358	0.41	47	4537	8.39	78	5678	15.69
17	3397	0.68	48	4575	8.64	79	5714	15.91
18	3436	0.94	49	4612	8.89	80	5750	16.14
19	3474	1.21	50	4650	9.13	81	5786	16.36
20	3513	1.48	51	4687	9.38	82	5822	16.58
21	3551	1.74	52	4724	9.62	83	5858	16.81
22	3590	2.01	53	4761	9.86	84	5894	17.03
23	3628	2.27	54	4798	10.10	85	5930	17.25
24	3667	2.54	55	4836	10.34	86	5966	17.47
25	3705	2.80	56	4873	10.58	87	6002	17.69
26	3743	3.07	57	4910	10.82	88	6038	17.91
27	3781	3.33	58	4947	11.06	89	6074	18.12
28	3820	3.59	59	4984	11.30	90	6109	18.34
29	3858	3.85	60	5021	11.54	91	6145	18.56
30	3896	4.11	61	5058	11.78	92	6181	18.78
31	3934	4.36	62	5095	12.01	93	6217	19.00
32	3972	4.62	63	5132	12.25	94	6252	19.21
33	4010	4.88	64	5169	12.48	95	6287	19.42
34	4048	5.14	65	5205	12.72	96	6323	19.63
35	4086	5.40	66	5242	12.95	97	6359	19.85
36	4124	5.65	67	5279	13.18	98	6394	20.06
37	4162	5.91	68	5316	13.41	99	6429	20.27
38	4199	6.16	69	5352	13.64	100	6464	20.48
39	4237	6.41	70	5388	13.87	101	6500	20.69
40	4275	6.66	71	5425	14.10	102	6535	20.90
41	4313	6.91	72	5461	14.33	103	6570	21.11
42	4350	7.16	73	5497	14.56	104	6605	21.32
43	4388	7.41	74	5633	14.79	105	6640	21.53
44	4426	7.66	75	5569	15.01			

[a] Values in this table were calcd by J. A. Mathews from five-place indices of Schönrock as given by Landt, *Z. Ver. Deut. Zucker-Ind.* 83, 692(1933).

[b] Scale readings refer only to scale of arbitrary units proposed by Pulfrich, *Z. Angew. Chem.* 1168(1899). According to this scale 14.5 = 1.33300, 50.0 = 1.34650, and 100.0 = 1.36464. If immersion refractometer used is calibrated according to another arbitrary scale, readings must be converted into refractive indices before this table is used to determine per cent sugar.

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Annex H
(normative)

Refractive Indices (*n*) of sucrose solutions at 20°—*Continued.*

n 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %
1.3580	16.449	1.3630	19.503	1.3680	22.487	1.3730	25.403	1.3780	28.253
1.3581	16.511	1.3631	19.564	1.3681	22.546	1.3731	25.460	1.3781	28.310
1.3582	16.573	1.3632	19.624	1.3682	22.605	1.3732	25.518	1.3782	28.366
1.3583	16.634	1.3633	19.684	1.3683	22.664	1.3733	25.576	1.3783	28.422
1.3584	16.696	1.3634	19.745	1.3684	22.723	1.3734	25.633	1.3784	28.479
1.3585	16.758	1.3635	19.805	1.3685	22.781	1.3735	25.691	1.3785	28.535
1.3586	16.819	1.3636	19.865	1.3686	22.840	1.3736	25.748	1.3786	28.591
1.3587	16.881	1.3637	19.925	1.3687	22.899	1.3737	25.806	1.3787	28.648
1.3588	16.943	1.3638	19.985	1.3688	22.958	1.3738	25.863	1.3788	28.704
1.3589	17.004	1.3639	20.045	1.3689	23.017	1.3739	25.921	1.3789	28.760
1.3590	17.066	1.3640	20.106	1.3690	23.075	1.3740	25.978	1.3790	28.816
1.3591	17.127	1.3641	20.166	1.3691	23.134	1.3741	26.035	1.3791	28.872
1.3592	17.189	1.3642	20.226	1.3692	23.193	1.3742	26.093	1.3792	28.928
1.3593	17.250	1.3643	20.286	1.3693	23.251	1.3743	26.150	1.3793	28.984
1.3594	17.311	1.3644	20.346	1.3694	23.310	1.3744	26.207	1.3794	29.040
1.3595	17.373	1.3645	20.406	1.3695	23.369	1.3745	26.265	1.3795	29.096
1.3596	17.434	1.3646	20.466	1.3696	23.427	1.3746	26.322	1.3796	29.152
1.3597	17.496	1.3647	20.525	1.3697	23.486	1.3747	26.379	1.3797	29.208
1.3598	17.557	1.3648	20.585	1.3698	23.544	1.3748	26.436	1.3798	29.264
1.3599	17.618	1.3649	20.645	1.3699	23.603	1.3749	26.493	1.3799	29.320
1.3600	17.679	1.3650	20.705	1.3700	23.661	1.3750	26.551	1.3800	29.376
1.3601	17.741	1.3651	20.765	1.3701	23.720	1.3751	26.608	1.3801	29.432
1.3602	17.802	1.3652	20.825	1.3702	23.778	1.3752	26.665	1.3802	29.488
1.3603	17.863	1.3653	20.884	1.3703	23.836	1.3753	26.722	1.3803	29.544
1.3604	17.924	1.3654	20.944	1.3704	23.895	1.3754	26.779	1.3804	29.600
1.3605	17.985	1.3655	21.004	1.3705	23.953	1.3755	26.836	1.3805	29.655
1.3606	18.046	1.3656	21.063	1.3706	24.011	1.3756	26.893	1.3806	29.711
1.3607	18.107	1.3657	21.123	1.3707	24.070	1.3757	26.950	1.3807	29.767
1.3608	18.168	1.3658	21.183	1.3708	24.128	1.3758	27.007	1.3808	29.823
1.3609	18.229	1.3659	21.242	1.3709	24.186	1.3759	27.064	1.3809	29.878
1.3610	18.290	1.3660	21.302	1.3710	24.244	1.3760	27.121	1.3810	29.934
1.3611	18.351	1.3661	21.361	1.3711	24.302	1.3761	27.178	1.3811	29.989
1.3612	18.412	1.3662	21.421	1.3712	24.361	1.3762	27.234	1.3812	30.045
1.3613	18.473	1.3663	21.480	1.3713	24.419	1.3763	27.291	1.3813	30.101
1.3614	18.534	1.3664	21.540	1.3714	24.477	1.3764	27.348	1.3814	30.156
1.3615	18.595	1.3665	21.599	1.3715	24.535	1.3765	27.405	1.3815	30.212
1.3616	18.655	1.3666	21.658	1.3716	24.593	1.3766	27.462	1.3816	30.267
1.3617	18.716	1.3667	21.718	1.3717	24.651	1.3767	27.518	1.3817	30.323
1.3618	18.777	1.3668	21.777	1.3718	24.709	1.3768	27.575	1.3818	30.378
1.3619	18.837	1.3669	21.836	1.3719	24.767	1.3769	27.632	1.3819	30.434
1.3620	18.898	1.3670	21.896	1.3720	24.825	1.3770	27.688	1.3820	30.489
1.3621	18.959	1.3671	21.955	1.3721	24.883	1.3771	27.745	1.3821	30.544
1.3622	19.019	1.3672	22.014	1.3722	24.941	1.3772	27.802	1.3822	30.600
1.3623	19.080	1.3673	22.073	1.3723	24.998	1.3773	27.858	1.3823	30.655
1.3624	19.141	1.3674	22.132	1.3724	25.056	1.3774	27.915	1.3824	30.711
1.3625	19.201	1.3675	22.192	1.3725	25.114	1.3775	27.971	1.3825	30.766
1.3626	19.262	1.3676	22.251	1.3726	25.172	1.3776	28.028	1.3826	30.821
1.3627	19.322	1.3677	22.310	1.3727	25.230	1.3777	28.084	1.3827	30.876
1.3628	19.382	1.3678	22.369	1.3728	25.287	1.3778	28.141	1.3828	30.932
1.3629	19.443	1.3679	22.428	1.3729	25.345	1.3779	28.197	1.3829	30.987

(Continued)

970.91 Refractive Indices (*n*) of sucrose solutions at 20°—*Continued.*

n 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %
1.3830	31.042	1.3880	33.771	1.3930	36.442	1.3980	39.059	1.4030	41.623
1.3831	31.097	1.3881	33.825	1.3931	36.495	1.3981	39.111	1.4031	41.674
1.3832	31.152	1.3882	33.879	1.3932	36.548	1.3982	39.163	1.4032	41.725
1.3833	31.207	1.3883	33.933	1.3933	36.601	1.3983	39.214	1.4033	41.776
1.3834	31.262	1.3884	33.987	1.3934	36.654	1.3984	39.266	1.4034	41.826
1.3835	31.317	1.3885	34.040	1.3935	36.706	1.3985	39.318	1.4035	41.877
1.3836	31.372	1.3886	34.094	1.3936	36.759	1.3986	39.370	1.4036	41.928
1.3837	31.428	1.3887	34.148	1.3937	36.812	1.3987	39.421	1.4037	41.978
1.3838	31.482	1.3888	34.202	1.3938	36.865	1.3988	39.473	1.4038	42.029
1.3839	31.537	1.3889	34.256	1.3939	36.917	1.3989	39.525	1.4039	42.080
1.3840	31.592	1.3890	34.310	1.3940	36.970	1.3990	39.576	1.4040	42.130
1.3841	31.647	1.3891	34.363	1.3941	37.023	1.3991	39.628	1.4041	42.181
1.3842	31.702	1.3892	34.417	1.3942	37.075	1.3992	39.679	1.4042	42.231
1.3843	31.757	1.3893	34.471	1.3943	37.128	1.3993	39.731	1.4043	42.282
1.3844	31.812	1.3894	34.524	1.3944	37.180	1.3994	39.782	1.4044	42.332
1.3845	31.867	1.3895	34.578	1.3945	37.233	1.3995	39.834	1.4045	42.383
1.3846	31.922	1.3896	34.632	1.3946	37.286	1.3996	39.885	1.4046	42.433
1.3847	31.976	1.3897	34.685	1.3947	37.338	1.3997	39.937	1.4047	42.484
1.3848	32.031	1.3898	34.739	1.3948	37.391	1.3998	39.988	1.4048	42.534
1.3849	32.086	1.3899	34.793	1.3949	37.443	1.3999	40.040	1.4049	42.585
1.3850	32.140	1.3900	34.846	1.3950	37.495	1.4000	40.091	1.4050	42.635
1.3851	32.195	1.3901	34.900	1.3951	37.548	1.4001	40.142	1.4051	42.685
1.3852	32.250	1.3902	34.953	1.3952	37.600	1.4002	40.194	1.4052	42.736
1.3853	32.304	1.3903	35.007	1.3953	37.653	1.4003	40.245	1.4053	42.786
1.3854	32.359	1.3904	35.060	1.3954	37.705	1.4004	40.296	1.4054	42.836
1.3855	32.414	1.3905	35.114	1.3955	37.757	1.4005	40.348	1.4055	42.887
1.3856	32.468	1.3906	35.167	1.3956	37.810	1.4006	40.399	1.4056	42.937
1.3857	32.523	1.3907	35.220	1.3957	37.862	1.4007	40.450	1.4057	42.987
1.3858	32.577	1.3908	35.274	1.3958	37.914	1.4008	40.501	1.4058	43.037
1.3859	32.632	1.3909	35.327	1.3959	37.967	1.4009	40.553	1.4059	43.088
1.3860	32.686	1.3910	35.380	1.3960	38.019	1.4010	40.604	1.4060	43.138
1.3861	32.741	1.3911	35.434	1.3961	38.071	1.4011	40.655	1.4061	43.188
1.3862	32.795	1.3912	35.487	1.3962	38.123	1.4012	40.706	1.4062	43.238
1.3863	32.849	1.3913	35.540	1.3963	38.175	1.4013	40.757	1.4063	43.288
1.3864	32.904	1.3914	35.593	1.3964	38.228	1.4014	40.808	1.4064	43.338
1.3865	32.958	1.3915	35.647	1.3965	38.280	1.4015	40.860	1.4065	43.388
1.3866	33.013	1.3916	35.700	1.3966	38.332	1.4016	40.911	1.4066	43.439
1.3867	33.067	1.3917	35.753	1.3967	38.384	1.4017	40.962	1.4067	43.489
1.3868	33.121	1.3918	35.806	1.3968	38.436	1.4018	41.013	1.4068	43.539
1.3869	33.175	1.3919	35.859	1.3969	38.488	1.4019	41.064	1.4069	43.589
1.3870	33.230	1.3920	35.912	1.3970	38.540	1.4020	41.115	1.4070	43.639
1.3871	33.284	1.3921	35.966	1.3971	38.592	1.4021	41.166	1.4071	43.689
1.3872	33.338	1.3922	36.019	1.3972	38.644	1.4022	41.217	1.4072	43.739
1.3873	33.392	1.3923	36.072	1.3973	38.696	1.4023	41.268	1.4073	43.789
1.3874	33.446	1.3924	36.125	1.3974	38.748	1.4024	41.318	1.4074	43.839
1.3875	33.500	1.3925	36.178	1.3975	38.800	1.4025	41.369	1.4075	43.888
1.3876	33.555	1.3926	36.231	1.3976	38.852	1.4026	41.420	1.4076	43.938
1.3877	33.609	1.3927	36.284	1.3977	38.904	1.4027	41.471	1.4077	43.988
1.3878	33.663	1.3928	36.337	1.3978	38.955	1.4028	41.522	1.4078	44.038
1.3879	33.717	1.3929	36.389	1.3979	39.007	1.4029	41.573	1.4079	44.088

(Continued)

Refractive Indices (*n*) of sucrose solutions at 20°—*Continued.*

n 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %
1.4080	44.138	1.4130	46.604	1.4180	49.023	1.4230	51.399	1.4280	53.733
1.4081	44.187	1.4131	46.652	1.4181	49.071	1.4231	51.446	1.4281	53.779
1.4082	44.237	1.4132	46.701	1.4182	49.119	1.4232	51.493	1.4282	53.825
1.4083	44.287	1.4133	46.750	1.4183	49.167	1.4233	51.540	1.4283	53.871
1.4084	44.337	1.4134	46.799	1.4184	49.215	1.4234	51.587	1.4284	53.918
1.4085	44.386	1.4135	46.848	1.4185	49.263	1.4235	51.634	1.4285	53.964
1.4086	44.436	1.4136	46.896	1.4186	49.311	1.4236	51.681	1.4286	54.010
1.4087	44.486	1.4137	46.945	1.4187	49.359	1.4237	51.728	1.4287	54.056
1.4088	44.535	1.4138	46.994	1.4188	49.407	1.4238	51.775	1.4288	54.102
1.4089	44.585	1.4139	47.043	1.4189	49.454	1.4239	51.822	1.4289	54.148
1.4090	44.635	1.4140	47.091	1.4190	49.502	1.4240	51.869	1.4290	54.194
1.4091	44.684	1.4141	47.140	1.4191	49.550	1.4241	51.916	1.4291	54.241
1.4092	44.734	1.4142	47.188	1.4192	49.598	1.4242	51.963	1.4292	54.287
1.4093	44.783	1.4143	47.237	1.4193	49.645	1.4243	52.010	1.4293	54.333
1.4094	44.833	1.4144	47.286	1.4194	49.693	1.4244	52.057	1.4294	54.379
1.4095	44.882	1.4145	47.334	1.4195	49.741	1.4245	52.104	1.4295	54.425
1.4096	44.932	1.4146	47.383	1.4196	49.788	1.4246	52.150	1.4296	54.471
1.4097	44.981	1.4147	47.431	1.4197	49.836	1.4247	52.197	1.4297	54.517
1.4098	45.031	1.4148	47.480	1.4198	49.884	1.4248	52.244	1.4298	54.563
1.4099	45.080	1.4149	47.528	1.4199	49.931	1.4249	52.291	1.4299	54.609
1.4100	45.130	1.4150	47.577	1.4200	49.979	1.4250	52.338	1.4300	54.655
1.4101	45.179	1.4151	47.625	1.4201	50.027	1.4251	52.384	1.4301	54.701
1.4102	45.228	1.4152	47.674	1.4202	50.074	1.4252	52.431	1.4302	54.746
1.4103	45.278	1.4153	47.722	1.4203	50.122	1.4253	52.478	1.4303	54.792
1.4104	45.327	1.4154	47.771	1.4204	50.169	1.4254	52.524	1.4304	54.838
1.4105	45.376	1.4155	47.819	1.4205	50.217	1.4255	52.571	1.4305	54.884
1.4106	45.426	1.4156	47.868	1.4206	50.264	1.4256	52.618	1.4306	54.930
1.4107	45.475	1.4157	47.916	1.4207	50.312	1.4257	52.664	1.4307	54.976
1.4108	45.524	1.4158	47.964	1.4208	50.359	1.4258	52.711	1.4308	55.022
1.4109	45.574	1.4159	48.013	1.4209	50.407	1.4259	52.758	1.4309	55.067
1.4110	45.623	1.4160	48.061	1.4210	50.454	1.4260	52.804	1.4310	55.113
1.4111	45.672	1.4161	48.109	1.4211	50.502	1.4261	52.851	1.4311	55.159
1.4112	45.721	1.4162	48.158	1.4212	50.549	1.4262	52.897	1.4312	55.205
1.4113	45.770	1.4163	48.206	1.4213	50.596	1.4263	52.944	1.4313	55.250
1.4114	45.820	1.4164	48.254	1.4214	50.644	1.4264	52.990	1.4314	55.296
1.4115	45.869	1.4165	48.302	1.4215	50.691	1.4265	53.037	1.4315	55.342
1.4116	45.918	1.4166	48.350	1.4216	50.738	1.4266	53.083	1.4316	55.388
1.4117	45.967	1.4167	48.399	1.4217	50.786	1.4267	53.130	1.4317	55.433
1.4118	46.016	1.4168	48.447	1.4218	50.833	1.4268	53.176	1.4318	55.479
1.4119	46.065	1.4169	48.495	1.4219	50.880	1.4269	53.223	1.4319	55.524
1.4120	46.114	1.4170	48.543	1.4220	50.928	1.4270	53.269	1.4320	55.570
1.4121	46.163	1.4171	48.591	1.4221	50.975	1.4271	53.316	1.4321	55.616
1.4122	46.212	1.4172	48.639	1.4222	51.022	1.4272	53.362	1.4322	55.661
1.4123	46.261	1.4173	48.687	1.4223	51.069	1.4273	53.408	1.4323	55.707
1.4124	46.310	1.4174	48.735	1.4224	51.116	1.4274	53.455	1.4324	55.752
1.4125	46.359	1.4175	48.784	1.4225	51.164	1.4275	53.501	1.4325	55.79[illegible]
1.4126	46.408	1.4176	48.832	1.4226	51.211	1.4276	53.548	1.4326	55.844
1.4127	46.457	1.4177	48.880	1.4227	51.258	1.4277	53.594	1.4327	55.889
1.4128	46.506	1.4178	48.928	1.4228	51.305	1.4278	53.640	1.4328	55.935
1.4129	46.555	1.4179	48.976	1.4229	51.352	1.4279	53.686	1.4329	55.980

(Continued)

Refractive indices (*n*) of sucrose solutions at 20°—*Continued.*

n 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %
1.4330	56.026	1.4380	58.279	1.4430	60.496	1.4480	62.677	1.4530	64.823
1.4331	56.071	1.4381	58.324	1.4431	60.540	1.4481	62.720	1.4531	64.865
1.4332	56.116	1.4382	58.369	1.4432	60.584	1.4482	62.763	1.4532	64.908
1.4333	56.162	1.4383	58.413	1.4433	60.628	1.4483	62.806	1.4533	64.950
1.4334	56.207	1.4384	58.458	1.4434	60.672	1.4484	62.849	1.4534	64.993
1.4335	56.253	1.4385	58.503	1.4435	60.716	1.4485	62.893	1.4535	65.035
1.4336	56.298	1.4386	58.547	1.4436	60.759	1.4486	62.936	1.4536	65.078
1.4337	56.343	1.4387	58.592	1.4437	60.803	1.4487	62.979	1.4537	65.120
1.4338	56.389	1.4388	58.637	1.4438	60.847	1.4488	63.022	1.4538	65.163
1.4339	56.434	1.4389	58.681	1.4439	60.891	1.4489	63.065	1.4539	65.205
1.4340	56.479	1.4390	58.726	1.4440	60.935	1.4490	63.108	1.4540	65.248
1.4341	56.525	1.4391	58.770	1.4441	60.979	1.4491	63.152	1.4541	65.290
1.4342	56.570	1.4392	58.815	1.4442	61.023	1.4492	63.195	1.4542	65.333
1.4343	56.615	1.4393	58.859	1.4443	61.066	1.4493	63.238	1.4543	65.375
1.4344	56.660	1.4394	58.904	1.4444	61.110	1.4494	63.281	1.4544	65.417
1.4345	56.706	1.4395	58.948	1.4445	61.154	1.4495	63.324	1.4545	65.460
1.4346	56.751	1.4396	58.993	1.4446	61.198	1.4496	63.367	1.4546	65.502
1.4347	56.796	1.4397	59.037	1.4447	61.241	1.4497	63.410	1.4547	65.544
1.4348	56.841	1.4398	59.082	1.4448	61.285	1.4498	63.453	1.4548	65.587
1.4349	56.887	1.4399	59.126	1.4449	61.329	1.4499	63.496	1.4549	65.629
1.4350	56.932	1.4400	59.170	1.4450	61.372	1.4500	63.539	1.4550	65.672
1.4351	56.977	1.4401	59.215	1.4451	61.416	1.4501	63.582	1.4551	65.714
1.4352	57.022	1.4402	59.259	1.4452	61.460	1.4502	63.625	1.4552	65.756
1.4353	57.067	1.4403	59.304	1.4453	61.503	1.4503	63.668	1.4553	65.798
1.4354	57.112	1.4404	59.348	1.4454	61.547	1.4504	63.711	1.4554	65.841
1.4355	57.157	1.4405	59.392	1.4455	61.591	1.4505	63.754	1.4555	65.883
1.4356	57.202	1.4406	59.437	1.4456	61.634	1.4506	63.797	1.4556	65.925
1.4357	57.247	1.4407	59.481	1.4457	61.678	1.4507	63.840	1.4557	65.967
1.4358	57.292	1.4408	59.525	1.4458	61.721	1.4508	63.882	1.4558	66.010
1.4359	57.337	1.4409	59.569	1.4459	61.765	1.4509	63.925	1.4559	66.052
1.4360	57.382	1.4410	59.614	1.4460	61.809	1.4510	63.968	1.4560	66.094
1.4361	57.427	1.4411	59.658	1.4461	61.852	1.4511	64.011	1.4561	66.136
1.4362	57.472	1.4412	59.702	1.4462	61.896	1.4512	64.054	1.4562	66.178
1.4363	57.517	1.4413	59.746	1.4463	61.939	1.4513	64.097	1.4563	66.221
1.4364	57.562	1.4414	59.791	1.4464	61.983	1.4514	64.139	1.4564	66.263
1.4365	57.607	1.4415	59.835	1.4465	62.026	1.4515	64.182	1.4565	66.305
1.4366	57.652	1.4416	59.879	1.4466	62.070	1.4516	64.225	1.4566	66.347
1.4367	57.697	1.4417	59.923	1.4467	62.113	1.4517	64.268	1.4567	66.389
1.4368	57.742	1.4418	59.967	1.4468	62.156	1.4518	64.311	1.4568	66.431
1.4369	57.787	1.4419	60.011	1.4469	62.200	1.4519	64.353	1.4569	66.473
1.4370	57.832	1.4420	60.056	1.4470	62.243	1.4520	64.396	1.4570	66.515
1.4371	57.877	1.4421	60.100	1.4471	62.287	1.4521	64.439	1.4571	66.557
1.4372	57.921	1.4422	60.144	1.4472	62.330	1.4522	64.481	1.4572	66.599
1.4373	57.966	1.4423	60.188	1.4473	62.373	1.4523	64.524	1.4573	66.641
1.4374	58.011	1.4424	60.232	1.4474	62.417	1.4524	64.567	1.4574	66.683
1.4375	58.056	1.4425	60.276	1.4475	62.460	1.4525	64.609	1.4575	66.725
1.4376	58.101	1.4426	60.320	1.4476	62.503	1.4526	64.652	1.4576	66.767
1.4377	58.145	1.4427	60.364	1.4477	62.547	1.4527	64.695	1.4577	66.809
1.4378	58.190	1.4428	60.408	1.4478	62.590	1.4528	64.737	1.4578	66.851
1.4379	58.235	1.4429	60.452	1.4479	62.633	1.4529	64.780	1.4579	66.893

(Continued)

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Refractive Indices (*n*) of sucrose solutions at 20°—*Continued*.

n 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %
1.4580	66.935	1.4630	69.016	1.4680	71.065	1.4730	73.084	1.4780	75.074
1.4581	66.977	1.4631	69.057	1.4681	71.106	1.4731	73.124	1.4781	75.114
1.4582	67.019	1.4632	69.096	1.4682	71.146	1.4732	73.164	1.4782	75.153
1.4583	67.061	1.4633	69.139	1.4683	71.187	1.4733	73.204	1.4783	75.193
1.4584	67.103	1.4634	69.181	1.4684	71.228	1.4734	73.244	1.4784	75.232
1.4585	67.145	1.4635	69.222	1.4685	71.268	1.4735	73.285	1.4785	75.272
1.4586	67.186	1.4636	69.263	1.4686	71.309	1.4736	73.325	1.4786	75.311
1.4587	67.228	1.4637	69.304	1.4687	71.349	1.4737	73.365	1.4787	75.350
1.4588	67.270	1.4638	69.346	1.4688	71.390	1.4738	73.405	1.4788	75.390
1.4589	67.312	1.4639	69.387	1.4689	71.431	1.4739	73.445	1.4789	75.429
1.4590	67.354	1.4640	69.428	1.4690	71.471	1.4740	73.485	1.4790	75.469
1.4591	67.396	1.4641	69.469	1.4691	71.512	1.4741	73.524	1.4791	75.508
1.4592	67.437	1.4642	69.510	1.4692	71.552	1.4742	73.564	1.4792	75.547
1.4593	67.479	1.4643	69.551	1.4693	71.593	1.4743	73.604	1.4793	75.587
1.4594	67.521	1.4644	69.593	1.4694	71.633	1.4744	73.644	1.4794	75.626
1.4595	67.563	1.4645	69.634	1.4695	71.674	1.4745	73.684	1.4795	75.666
1.4596	67.604	1.4646	69.675	1.4696	71.714	1.4746	73.724	1.4796	75.705
1.4597	67.646	1.4647	69.716	1.4697	71.755	1.4747	73.764	1.4797	75.744
1.4598	67.688	1.4648	69.757	1.4698	71.795	1.4748	73.804	1.4798	75.784
1.4599	67.729	1.4649	69.798	1.4699	71.836	1.4749	73.844	1.4799	75.823
1.4600	67.771	1.4650	69.839	1.4700	71.876	1.4750	73.884	1.4800	75.862
1.4601	67.813	1.4651	69.880	1.4701	71.917	1.4751	73.924	1.4801	75.901
1.4602	67.854	1.4652	69.921	1.4702	71.957	1.4752	73.963	1.4802	75.941
1.4603	67.896	1.4653	69.962	1.4703	71.998	1.4753	74.003	1.4803	75.980
1.4604	67.938	1.4654	70.003	1.4704	72.038	1.4754	74.043	1.4804	76.019
1.4605	67.979	1.4655	70.044	1.4705	72.078	1.4755	74.083	1.4805	76.058
1.4606	68.021	1.4656	70.085	1.4706	72.119	1.4756	74.123	1.4806	76.098
1.4607	68.063	1.4657	70.126	1.4707	72.159	1.4757	74.162	1.4807	76.137
1.4608	68.104	1.4658	70.167	1.4708	72.199	1.4758	74.202	1.4808	76.176
1.4609	68.146	1.4659	70.208	1.4709	72.240	1.4759	74.242	1.4809	76.215
1.4610	68.187	1.4660	70.249	1.4710	72.280	1.4760	74.282	1.4810	76.254
1.4611	68.229	1.4661	70.290	1.4711	72.320	1.4761	74.321	1.4811	76.294
1.4612	68.270	1.4662	70.331	1.4712	72.361	1.4762	74.361	1.4812	76.333
1.4613	68.312	1.4663	70.372	1.4713	72.401	1.4763	74.401	1.4813	76.372
1.4614	68.353	1.4664	70.413	1.4714	72.441	1.4764	74.441	1.4814	76.411
1.4615	68.395	1.4665	70.453	1.4715	72.482	1.4765	74.480	1.4815	76.450
1.4616	68.436	1.4666	70.494	1.4716	72.522	1.4766	74.520	1.4816	76.489
1.4617	68.478	1.4667	70.535	1.4717	72.562	1.4767	74.560	1.4817	76.528
1.4618	68.519	1.4668	70.576	1.4718	72.602	1.4768	74.599	1.4818	76.567
1.4619	68.561	1.4669	70.617	1.4719	72.643	1.4769	74.639	1.4819	76.607
1.4620	68.602	1.4670	70.658	1.4720	72.683	1.4770	74.678	1.4820	76.646
1.4621	68.643	1.4671	70.698	1.4721	72.723	1.4771	74.718	1.4821	76.685
1.4622	68.685	1.4672	70.739	1.4722	72.763	1.4772	74.758	1.4822	76.724
1.4623	68.726	1.4673	70.780	1.4723	72.803	1.4773	74.797	1.4823	76.763
1.4624	68.768	1.4674	70.821	1.4724	72.843	1.4774	74.837	1.4824	76.802
1.4625	68.809	1.4675	70.861	1.4725	72.884	1.4775	74.876	1.4825	76.841
1.4626	68.850	1.4676	70.902	1.4726	72.924	1.4776	74.916	1.4826	76.880
1.4627	68.892	1.4677	70.943	1.4727	72.964	1.4777	74.956	1.4827	76.919
1.4628	68.933	1.4678	70.984	1.4728	73.004	1.4778	74.995	1.4828	76.958
1.4629	68.974	1.4679	71.024	1.4729	73.044	1.4779	75.035	1.4829	76.997

(Continued)

970.91 Refractive indices (*n*) of sucrose solutions at 20°—*Concluded.*

n 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %	*n* 20°	Sucrose, %
1.4830	77.036	1.4880	78.969	1.4930	80.876	1.4980	82.755	1.5030	84.609
1.4831	77.075	1.4881	79.008	1.4931	80.913	1.4981	82.793	1.5031	84.645
1.4832	77.113	1.4882	79.046	1.4932	80.951	1.4982	82.830	1.5032	84.682
1.4833	77.152	1.4883	79.084	1.4933	80.989	1.4983	82.867	1.5033	84.719
1.4834	77.191	1.4884	79.123	1.4934	81.027	1.4984	82.905	1.5034	84.756
1.4835	77.230	1.4885	79.161	1.4935	81.065	1.4985	82.942	1.5035	84.792
1.4836	77.269	1.4886	79.199	1.4936	81.103	1.4986	82.979	1.5036	84.829
1.4837	77.308	1.4887	79.238	1.4937	81.140	1.4987	83.016	1.5037	84.866
1.4838	77.347	1.4888	79.276	1.4938	81.178	1.4988	83.054	1.5038	84.903
1.4839	77.386	1.4889	79.314	1.4939	81.216	1.4989	83.091	1.5039	84.939
1.4840	77.425	1.4890	79.353	1.4940	81.254	1.4990	83.128	1.5040	84.976
1.4841	77.463	1.4891	79.391	1.4941	81.291	1.4991	83.165	1.5041	85.013
1.4842	77.502	1.4892	79.429	1.4942	81.329	1.4992	83.202	1.5042	85.049
1.4843	77.541	1.4893	79.468	1.4943	81.367	1.4993	83.240	1.5043	85.086
1.4844	77.580	1.4894	79.506	1.4944	81.405	1.4994	83.277	1.5044	85.123
1.4845	77.619	1.4895	79.544	1.4945	81.442	1.4995	83.314	1.5045	85.159
1.4846	77.657	1.4896	79.582	1.4946	81.480	1.4996	83.351	1.5046	85.196
1.4847	77.696	1.4897	79.620	1.4947	81.518	1.4997	83.388	1.5047	85.233
1.4848	77.735	1.4898	79.659	1.4948	81.555	1.4998	83.425	1.5048	85.269
1.4849	77.774	1.4899	79.697	1.4949	81.593	1.4999	83.463	1.5049	85.306
1.4850	77.812	1.4900	79.735	1.4950	81.631	1.5000	83.500	1.5050	85.343
1.4851	77.851	1.4901	79.773	1.4951	81.668	1.5001	83.537	1.5051	85.379
1.4852	77.890	1.4902	79.811	1.4952	81.706	1.5002	83.574	1.5052	85.416
1.4853	77.928	1.4903	79.850	1.4953	81.744	1.5003	83.611	1.5053	85.452
1.4854	77.967	1.4904	79.888	1.4954	81.781	1.5004	83.648	1.5054	85.489
1.4855	78.006	1.4905	79.926	1.4955	81.819	1.5005	83.685	1.5055	85.525
1.4856	78.045	1.4906	79.964	1.4956	81.856	1.5006	83.722	1.5056	85.562
1.4857	78.083	1.4907	80.002	1.4957	81.894	1.5007	83.759	1.5057	85.598
1.4858	78.122	1.4908	80.040	1.4958	81.932	1.5008	83.796	1.5058	85.635
1.4859	78.160	1.4909	80.078	1.4959	81.969	1.5009	83.833	1.5059	85.672
1.4860	78.199	1.4910	80.116	1.4960	82.007	1.5010	83.870	1.5060	85.708
1.4861	78.238	1.4911	80.154	1.4961	82.044	1.5011	83.907	1.5061	85.744
1.4862	78.276	1.4912	80.192	1.4962	82.082	1.5012	83.944	1.5062	85.781
1.4863	78.315	1.4913	80.231	1.4963	82.119	1.5013	83.981	1.5063	85.817
1.4864	78.353	1.4914	80.269	1.4964	82.157	1.5014	84.018	1.5064	85.854
1.4865	78.392	1.4915	80.307	1.4965	82.194	1.5015	84.055	1.5065	85.890
1.4866	78.431	1.4916	80.345	1.4966	82.232	1.5016	84.092	1.5066	85.927
1.4867	78.469	1.4917	80.383	1.4967	82.269	1.5017	84.129	1.5067	85.963
1.4868	78.508	1.4918	80.421	1.4968	82.307	1.5018	84.166	1.5068	86.000
1.4869	78.546	1.4919	80.459	1.4969	82.344	1.5019	84.203	1.5069	86.036
1.4870	78.585	1.4920	80.497	1.4970	82.381	1.5020	84.240	1.5070	86.072
1.4871	78.623	1.4921	80.534	1.4971	82.419	1.5021	84.277	1.5071	86.109
1.4872	78.662	1.4922	80.572	1.4972	82.456	1.5022	84.314	1.5072	86.145
1.4873	78.700	1.4923	80.610	1.4973	82.494	1.5023	84.351	1.5073	86.182
1.4874	78.739	1.4924	80.648	1.4974	82.531	1.5024	84.388	1.5074	86.218
1.4875	78.777	1.4925	80.686	1.4975	82.569	1.5025	84.424	1.5075	86.254
1.4876	78.816	1.4926	80.724	1.4976	82.606	1.5026	84.461	1.5076	86.291
1.4877	78.854	1.4927	80.762	1.4977	82.643	1.5027	84.498	1.5077	86.327
1.4878	78.892	1.4928	80.800	1.4978	82.681	1.5028	84.535	1.5078	86.363
1.4879	78.931	1.4929	80.838	1.4979	82.718	1.5029	84.572	1.5079	86.399

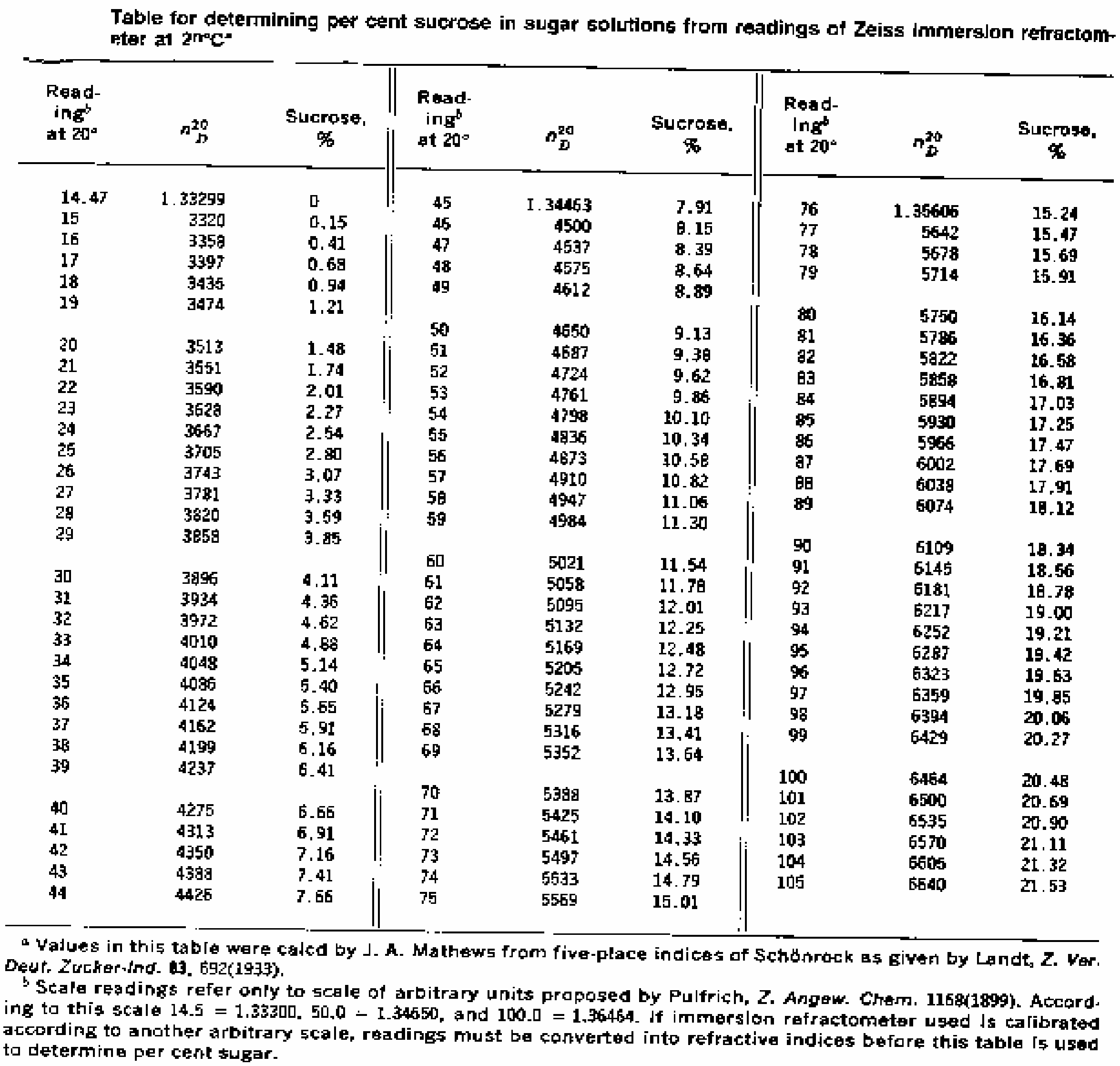

Table for determining per cent sucrose in sugar solutions from readings of Zeiss immersion refractometer at 20°C[a]

Reading[b] at 20°	n_D^{20}	Sucrose, %	Reading[b] at 20°	n_D^{20}	Sucrose, %	Reading[b] at 20°	n_D^{20}	Sucrose, %
14.47	1.33299	0	45	1.34463	7.91	76	1.35606	15.24
15	3320	0.15	46	4500	8.15	77	5642	15.47
16	3358	0.41	47	4537	8.39	78	5678	15.69
17	3397	0.68	48	4575	8.64	79	5714	15.91
18	3436	0.94	49	4612	8.89	80	5750	16.14
19	3474	1.21	50	4650	9.13	81	5786	16.36
20	3513	1.48	51	4687	9.38	82	5822	16.58
21	3551	1.74	52	4724	9.62	83	5858	16.81
22	3590	2.01	53	4761	9.86	84	5894	17.03
23	3628	2.27	54	4798	10.10	85	5930	17.25
24	3667	2.54	55	4836	10.34	86	5966	17.47
25	3705	2.80	56	4873	10.58	87	6002	17.69
26	3743	3.07	57	4910	10.82	88	6038	17.91
27	3781	3.33	58	4947	11.06	89	6074	18.12
28	3820	3.59	59	4984	11.30	90	6109	18.34
29	3858	3.85	60	5021	11.54	91	6145	18.56
30	3896	4.11	61	5058	11.78	92	6181	18.78
31	3934	4.36	62	5095	12.01	93	6217	19.00
32	3972	4.62	63	5132	12.25	94	6252	19.21
33	4010	4.88	64	5169	12.48	95	6287	19.42
34	4048	5.14	65	5205	12.72	96	6323	19.63
35	4086	5.40	66	5242	12.95	97	6359	19.85
36	4124	5.65	67	5279	13.18	98	6394	20.06
37	4162	5.91	68	5316	13.41	99	6429	20.27
38	4199	6.16	69	5352	13.64	100	6464	20.48
39	4237	6.41	70	5388	13.87	101	6500	20.69
40	4275	6.66	71	5425	14.10	102	6535	20.90
41	4313	6.91	72	5461	14.33	103	6570	21.11
42	4350	7.16	73	5497	14.56	104	6605	21.32
43	4388	7.41	74	5533	14.79	105	6640	21.53
44	4426	7.66	75	5569	15.01			

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[a] Values in this table were calcd by J. A. Mathews from five-place indices of Schönrock as given by Landt, *Z. Ver. Deut. Zucker-Ind.* **83**, 692(1933).

[b] Scale readings refer only to scale of arbitrary units proposed by Pulfrich, *Z. Angew. Chem.* 1168(1899). According to this scale 14.5 = 1.33300, 50.0 = 1.34650, and 100.0 = 1.36464. If immersion refractometer used is calibrated according to another arbitrary scale, readings must be converted into refractive indices before this table is used to determine per cent sugar.

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Ethiopian Standards Agency

Organization and Objectives

The Ethiopian Standards Agency (ESA) is the national standards body of Ethiopia established in 2010 based on regulation No. 193/2010.ESA is established due to the restructuring of Quality and Standards Authority of Ethiopia (QSAE) which was established in 1970.

ESA's objectives are:-

- Develop Ethiopian standards and establish a system that enable to check weather goods and services are in compliance with the required standards,
- Facilitate the country's technology transfer through the use of standards,
- Develop national standards for local products and services so as to make them competitive in the international market.

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